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The Strategic Position of the United States

Some notes on the defensive strength of the United States and its dependencies resulting from a consideration of the geographic location of our continental and overseas possessions and the distribution of our resources

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IN preparing plans for the defense of any locality certain factors should be kept in mind. Among these may be mentioned the following:

First: The value to ourselves—how far the position is necessary to us in war and in peace;

Second: The value to an enemy—to what extent would its capture enable him to increase his opportunity for imposing his will in the terms for peace;

Third: The natural defensive strength of the position as determined by a study of local geography, hydrography, climate, and resources;

Fourth: Its relation to other positions—is it supported by them or is it isolated;

Fifth: Can the position be reinforced promptly and certainly;

Sixth: Existing or potential bases from which an attacking force may operate.

All of these have a distinct bearing both upon the probability of attack and upon the character of attack to be anticipated. We may be certain that an enemy will consider them all; we certainly should omit none in our own studies. There are positions of such importance as to justify a complete defense regardless of support; there are others where it would be advantageous to ourselves to have an enemy commit himself. The former should be protected so as to discourage plans for attack; the latter should be left undefended.

The following discussion attempts to cover a broad field in a brief presentation. There is no single point that is not capable and worthy

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of considerable development. For example, practically every position or group of positions discussed has its field in offensive as well as defensive strategy; only the latter is touched upon. And of the six considerations to be held in mind only the fourth and sixth are gone into to any extent. It is believed, in plans initiated locally, the third has received consideration equal to if not greater than the others combined.

In his writings Mahan frequently invited attention to the fact that the strategic value of a position depended upon three things: Its location; its natural strength; its resources. Of these, he stated the first to be of greatest importance. While a position can be strengthened by artificial means, and while resources, if lacking, can be provided by the storage of reserve supplies, no human agency can move a position from one geographic location to another.

Mahan had in mind, of course, positions of limited extent. Effort is made in this article to touch upon the strategic strength, both of the Continental United States and of some of its dependencies. As far as resources are concerned little need be said other than that the United States are more nearly self sustaining, under the standards demanded by modern war, than is any other nation—that the items of raw material we must have the forethought to secure and store are very few in number. It might be mentioned also, as to man power, that we can create a larger force of fairly homogeneous stock than can any other nation except China and Russia and, due to resources and industrial development, can maintain a larger army than either of these. There remains our location and its natural strength.

It has been said that the oceans are no longer barriers—that they have become highways. This is true to the extent that troops can be moved by ships more economically, with less fatigue, and generally more expeditiously than by other means. But, lacking harbors for bases, and lacking also a complete control of the seas (complete control is now almost impossible to secure, due to the developments in submarines and aircraft), the oceans still constitute a barrier that cannot be disregarded.

Certainly there is no comparison of a nation whose frontiers are separated from the frontiers of others by several thousand miles of water, with a nation whose frontiers abut upon those of nations of approximately equal power and in areas where the railroad net and road systems permit the concentration, on the frontier and in battle formation, of great armies whose supply is covered and assured by the concentration. When the possibilities of damaging air attack coincident with the declaration of war are considered, the contrast becomes even greater.

The land frontiers of the United States border on Canada and Mexico. Both of these countries contain ample resources as to shelter and food for a modern army; neither has the capacity for munitioning a balanced force, nor is there any reason to anticipate an industrial development in either that would tend to result in such capacity. The bulk of the munitions would have to come from overseas—to Canada over favorable lines of communication from the east and over rather unfavorable lines of communication from the west; to Mexico over lines of communication, a considerable portion of which are dominated by existing or potential United States bases.

The Canadian border from Lake Michigan to Maine abuts upon an area vital to the United States. West of Lake Michigan there are sectors of varying importance, though none could be classed as vital; it should be noted that the development of communication is far superior south of the border. An invasion from any portion of Mexico would have to penetrate deeply before affecting materially the war-making power of the United States and only along the west coast and in Texas could any especially important utility be affected. Excepting the Great Lakes and the Rocky Mountains, there are no natural obstacles to invasion along our northern frontier; the desert lands of Northern Mexico and of our own Southwest are serious obstacles along the greater part of our southern land frontier.

To study the sea frontiers it is best to use the great circle charts plotted on a projection making a straight line on the map the shortest distance between any two points. An outline sketch of such a chart is shown in Plate I. In studying this chart it must be borne in mind that it is not to scale and distances cannot be taken from it. The same results may be had from the study of a globe with the advantage of being able to measure the distances.

In so far as the shortest distance is concerned, it is to be noted that the Atlantic coastline of the United States lies practically in prolongation of the routes from the northern Europe, as well as from Canadian, ports. The strategic effect of this is to place every base or potential base on our Atlantic seaboard on the flank of the line of communications from northern Europe to every port more retired. That is, the Kennebec, Portland, Portsmouth, and Boston are all advantageously located for operations against an European force attempting to capture Narragansett Bay; similarly, these four and Narragansett Bay serve to protect New York. The farther to the southwest an enemy makes his objective, the longer and more exposed will be his lines of communication and the greater the number of bases he must capture or neutralize. In fact, it appears that a step by step reduction of the defended harbors

named would be the only method of procedure promising entire security of communication to an enemy based on northern European ports. Our northeastern bases may be likened to the advance guard of a column halted for the night.

As for possible bases of operations near at hand, the coast of Canada offers several harbors suitable in natural features, only one of which, however, is developed. Operations from these bases would be affected by the trend of our coastline in the manner indicated in the foregoing paragraph. The Bermudas lie directly off our coast on a line perpendicular to the center of our most vital area. While these islands are suitable for an advanced base for a minor operation, a considerable amount of dredging would be necessary before capital ships and large transports could enter. Furthermore, supplies of all kinds would have to be accumulated. A major operation, such as those mentioned later, could not be based thereon without extensive improvements. The Bahamas are less advantageously placed than are the Bermudas, and the lesser Antilles can be disregarded as a threat to our Atlantic coast, assuming that we hold the Virgin Islands and Porto Rico and that the Republics of Haiti, Santo Domingo, and Cuba are our allies or are neutral. Only by inconceivable stupidity in our own conduct of diplomacy, and a complete forgetfulness of their own future best interests, would any of the three countries named be found in coalition against us.

The friendship of Cuba has resulted in making the Gulf of Mexico an American sea. Formerly the Yucatan Channel was open to the ships of an enemy, while our own shipping had to pass through the Florida Straits along the shores of a possibly hostile country. Now the Straits are entirely dominated by us and, with the active alliance to be expected normally of Cuba, the Yucatan Channel is only less so. The Gulf of Mexico is to the United States what the Gulf of St. Lawrence is to Canada.

Summed up, our Atlantic and Gulf sea frontiers, judged by Mahan's standards, are admirably conditioned both as to location and as to resources. This article will not go into the strengthening of the position by fortifications and trained personnel.

Turning to our western sea frontier, we find a not dissimilar situation to exist. Plate II is approximately a great circle chart, being truly so on the great circle passing from Northern Luzon through Central America. Our west coast contains comparatively few first-class harbors—Puget Sound, the Columbia, San Francisco, Los Angeles, and San Diego. From south to north each is protected by those further north, though not to so marked a degree as obtains for our Atlantic seaboard; and

on the flank of the lines of communication from Asia lie the Hawaiian Islands with good harbors and large resources, both natural and in storage, and the Aleutian Islands with good harbors but without resources.

Some distances are appropriate in view of the distortion of the chart.

From Yokahama to San Francisco is 4536 miles.

From Oahu to this route is about 1500 miles.

From Unalaska to this route is about 500 miles.

Hence the last two-fifths of this route is threatened from flank and rear by our existing and potential bases, and a detour to the south to avoid these bases by an equal distance would approximately double the travel of a fleet. It would appear that these bases must be neutralized before a major operation against our west coast can be undertaken with reasonable safety for the line of communication.

Both to the north and the south of our west coast are strong natural positions. There are several excellent harbors, two of them well developed, on the Canadian Coast, and one on the Coast of Lower California, the last being undeveloped and backed by meager resources. All are dominated by the position and the strength of our own bases and by the much greater resources supporting them.

With the foregoing background as to our frontiers, it remains to examine into the areas where an invasion would cripple our war making power. Roughly speaking, a line from Norfolk to Chicago divides our industrial area from our agricultural area, though the absolute separation of the two would not leave the former so reduced as to foods as was Germany, nor the latter so unfortunately placed for manufactured articles as was Russia, during the last half of the World War. However, there is no minimizing the fact that our development has made the different sections of our country interdependent to a marked degree, and that a deep penetration of certain portions of our industrial area would materially lessen our war making power.

With these facts in mind, we may consider certain possible lines of invasion and their effects:

1. Chesapeake Bay—the Potomac to Cumberland—thence northwest to the Youghiogheny—along the Youghiogheny to Pittsburg—thence along the Allegheny to Ore City—thence across country to Erie. This line would be favorable for penetration in some areas, difficult in others. If occupied it would have the advantage of a major water obstacle for two thirds its extent. It would separate the industrial and agricultural areas, not so completely as the line Norfolk–Chicago, but very decisively. Given control of Lake Erie and of the North Atlantic, simultaneous effort by well-prepared, well-equipped armies from the

north and southeast would find no insuperable natural obstacle. However, the forces would have to be very large; their assembly and maintenance would be difficult. The force assembled at Lake Erie must be transported and supplied over routes (few in number) paralleling our northern frontier. Unless protected by forces equal to those we could assemble during the concentration, we could thrust north and break the lines of communication. With our population and resources the northern expedition appears practically impossible. Similarly, the selection of Chesapeake Bay as a base would leave our forces based upon northern harbors on the immediate flank of the lines of communication (see Plate I).

2. A more favorable line, in that the forces required would be smaller, is the following:

Chesapeake Bay—the Susquehanna and Erie Rivers to Elmira, New York—thence overland to Lake Cayuga and from the northern point of Lake Cayuga to Lake Ontario. The country is much more favorable, and the line, when occupied, much stronger in that all but about fifty miles has even more formidable water obstacles than the line first mentioned. It would still be effective in seriously crippling the balanced supply of our armies and population. Except that fewer men and hence fewer supplies and a shorter time for concentration would be required, the same difficulties confronting the first plan would be met.

3. Delaware Bay—Delaware River—Lake Cayuga—Lake Ontario. This is a shorter route over still more favorable terrain. It passes through the heart of our munition area. The sea lines of communication are somewhat shortened and there is one less base threatening their flank. The difficulty of concentrating the northern force would be less than those of the two preceding cases only in that smaller numbers would be required.

4. New York City—the Hudson—Lake Champlain. The difficulty of the northern concentration is materially lessened due to shortened and less exposed lines of communication and the smaller numbers required; it has become a possibility not beyond reason. The southern expedition for the seizure of New York City would face a serious risk. Unless the bases to the north and south were neutralized, such an effort would suffer all the hazards of attack upon a re-entrant in an unshaken line. Such efforts have usually resulted disastrously in tactical operations; and in strategy also, unless pushed through to prompt and complete success, have generally failed. Furthermore, the occupation of this line, while it would ruin New England, would deprive the balance of the country of many important items such as the bulk of the leather,

wool, and rubber products, and would disrupt the finances to a serious extent, would not reduce decisively the ultimate strength of our counter offensive.

5. Through Boston and Massachusetts to the Hudson, combined with an attack from the north via Lake Champlain, with the ultimate objective of occupying the line discussed in paragraph 4. By raids to occupy the Kennebec, Portland and Portsmouth, and with a screen south of Cape Cod, the dangers of efforts previously discussed are minimized. The result, however, would not be decisive. Time would permit of at least a partial adjustment of finance and the preparation of a counter offensive which might prevent the junction of the two forces.

From the foregoing it is seen that operations capable of producing a prompt and decisive result are all precarious due to the strategic location of our bases and to the position of our northern frontier with respect to Canada's lines of communication. Also that, as the plan is curtailed to reduce the risk of complete failure, the effect of success also is reduced until, when an effort promising reasonable expectation of success is reached, the effect ceases to be decisive and could not result in our suing for peace.

Attacks in other areas might prove embarrassing, but could lead to no decision unless coupled with a major operation such as one of those outlined above. The interruption of lake traffic at Sault Ste. Marie, the seizure of the Puget Sound area, the occupation of the oil fields of Southern California or Texas, or of the industrial areas of Georgia and Alabama, would all be damaging, as would a raid cutting the railroad lines between Philadelphia and New York. But the effect would be only temporary—an enemy incapable of making a greater effort would be wise to attempt none.

Turning now to our overseas possessions, these will be discussed briefly in turn.

The Philippine Islands have resources to feed and shelter armed forces sufficient for their defense, but lack industrial development. Their distance from our manufacturing area renders the supply of munitions in quantity, after war is declared, difficult if not impracticable. To store sufficient munitions, and to maintain them, in a tropical climate, against the possibilities of war would be an expense unjustifiable. We must accept the islands as a strategic liability. Their best defense would be an offensive move, by our main forces from the United States, against the vitals of the enemy, rather than a reinforcement of our forces in the Islands. No decisive result would come of success or failure of the campaign in the islands themselves; their ultimate disposition would be decided by success or failure elsewhere.

From any point of view Guam is less tenable than are the Philippines.

The Hawaiian Islands lie nearer our coast than the coasts of any other power. The most important island, Oahu, is admirably fitted by natural strength for a fortress. The island could be made to sustain the force necessary for its defense. Munitions must be stored and replenished, and proximity to our coasts makes this possible. The isolation of the islands, their position as an outpost of our west coast, their fitness as a concentration point for further operations, and their size, all render them an objective for a surprise major operation at the outbreak of war. Few positions in the world dominate an area so decisively as the Hawaiian Islands do the North Pacific. They are vital, both to ourselves and to any enemy operating in that ocean.

The Aleutian Islands, save for fogs, irregular currents, storms, and lack of resources, would be second only to the Hawaiian Islands in the strategy of the North Pacific. Even with their drawbacks they cannot escape consideration.

Alaska has a climate that is its best defense. It can play no major portion in any struggle, and is a strategic consideration only as a staging point in possible air operations.

The Panama Canal is the most important of our overseas holdings, and its strategic position will be considered more in detail, both because of its interest and also because the foregoing discussion has been so sketchy in character that it could scarcely be called a study.

Taking first the Pacific, we see from Plate II that all routes from Asia are very long, beyond the cruising radius of any but the larger ships. We find also the absence of suitable bases enroute excepting our own ports and a few ports in Canada. There are also a few potential bases in Mexican and Central American ports. But there are none on any direct route from Asia not held by the United States, the communication with which from Asia are not threatened by one or more of our bases. This means that for security these bases must be captured or neutralized or that a wide detour to the south must be made.

The shortest detour offering any sheltered anchorages enroute is more than 3000 miles longer than the direct route. None of these anchorages pertain to islands having resources suitable for the service of a fleet; they belong or are mandated to various nations, a factor limiting the accumulation of supplies for the conduct of war by any special nation. And, if we are prevented by economic reasons from storing munitions in the Philippines as a precaution against some problematic future war, how much less likely is any other nation to develop a base in the central Pacific for the sole purpose of making

possible, at some future date (under conditions so difficult as to make the outcome more than doubtful), an expedition against the Panama Canal. For even at best the conditions would be difficult. The nearest group of islands, the Marquesas, is over 4000 miles from the Canal. A fleet based thereon, even allowing a base had been developed, would have to meet a fleet with one base (the Canal itself) immediately at hand and with another base (San Francisco) at a distance approximately 1000 miles less than the presumed enemy base. Allowing substantially the same force, and eliminating accidents, the outcome of such a naval campaign is obvious.

The situation would be at once reversed should the enemy be based on the South American Coast. From a strategically well protected location, Panama would become a very exposed one. So far, no west coast South American nation has developed great naval power, nor has any concluded an alliance with any maritime nation.

In the Atlantic the distances are much shorter. On the other hand, the United States actually holds or has practical alliance with the nations holding the great majority of anchorages suitable for development into a fleet base in the Caribbean area. Great Britain has two. We hold or control the balance. Only one (in the Canal Zone) has been developed. Should others be initiated the proximity of our shores and our resources would give us a great advantage in the race. And we would undoubtedly proceed to develop a defended fleet base in the Antilles should any other nation undertake to do so since such action could have but one object—to dominate the Caribbean and hence the routes to the Canal.

Reference was made to the Gulf of Mexico as being an American sea. The Caribbean Sea is only less so. To gain an idea of the strength of our strategic position one need only read history. Always an important area, the control of the Caribbean has been multiplied in value by the construction of the Panama Canal. And yet we see no nation moving toward that end. The Caribbean was an area of contest for centuries—practically all maritime nations have or had holdings there; practically all fought for supremacy. But when the United States secured Porto Rico and was practically assured of the alliance of Cuba and the Dominican Republics, Europe's interest flagged. The trained statesmen and strategists realized the hopelessness of the contest. Even Great Britain, which had theretofore demanded an equal share in any canal that might be constructed and had treaties guaranteeing this, changed her policy completely.

The chain of islands from Cuba to the Virgins gives us not only protected sea routes two-thirds of the way around the Caribbean, but

also an excellent air route. These, with the proximity to our bases and supplies, gives to the United States an advantage that is preponderating. Interruption of our communications is almost impossible, and would have to be of considerable duration in order to be serious on account of the size and resources of the islands in the chain. The communications of the enemy would be constantly threatened from flank and rear.

The conclusion seems obvious that, in the present state of development of South America, Panama's strategic position is defensively one of the strongest in the world.

Before concluding the discussion of our strategic strength from the defensive standpoint something seems appropriate as to resources. That we are practically self-supporting has been mentioned. That we have within our continental borders approximately one-half of the world's supply of most of the raw materials essential to the manufacture of munitions is equally important, for it makes our alliance of great value and our enmity a serious threat to any nation engaged in war. We hold also one of the bottle necks on the routes of the world's commerce and have power to grant or deny its use at will. These factors, so deeply affecting the supply of other nations, are in themselves a great asset in defensive strategy since (to reverse Clausewitz) diplomacy strives to accomplish the objects which would otherwise have to be gained by war, and hence its strategy replaces frequently, and precedes invariably, the strategy of war.

In conclusion it may be said that the strategic strength of a position is of value only in simplifying and making more economical its defense. In itself it is no defense at all. For, to be of value, any area must be accessible, and, if accessible it may be occupied by an enemy unless defended by men organized, trained and munitioned for modern warfare.

APHORISME XX

Despaire taketh Arms when all hope of escape is absent, for necessity makes the most imbellick cowards valiant; wherefore it is wisdome to leave thy enemie a port open to flie, and rather build him a bridge of gold to passe over, than coup him in a place, that either hee must fight, or perish.—Ward's Animadversions of War *(London, 1639).*

Preparation and Adjustment of Antiaircraft Fire

By CAPTAIN BENJAMIN F. HARMON, *61st C. A. (AA)*

Second Prize (Tie), Annual Prize Essay Competition

WE returned from France carrying a heavy burden of dogmas, doctrines, principles, inhibitions, and what not, most of which are based on the solid foundation of experience in war and are exceedingly sound. Simple catch phrases keep many of them ever before us. Who does not remember that "a battery seen is a battery lost?" What antiaircraft artilleryman will ever forget that our friends and instructors of the French school at Arnouville-les-Gonesse insisted that "Antiaircraft fire must be prepared—it cannot be adjusted?" That inhibition was sound as a new minted coin at the time; but a new era is opening, and a ray of light is appearing through the darkness that prevented our improving fire during action. Daylight is still far off but now one can grope his way with some degree of assurance.

Why could not antiaircraft fire be adjusted? When the reasons impelling the prohibition against adjustment are analyzed, it will be learned that there is only one change that has been brought into antiaircraft position finding since 1918 that warrants an assumption of the practicabilitl of adjustment: That change is the addition of the stereoscopic height finders; otherwise the old objections still hold:

1. In time of war, with sound tactical distribution of units, a target should be engaged normally by two or three batteries simultaneously (8 or 12 guns). It was, in 1918, and still will be, impossible to unscramble the resultant mass of bursts and identify those of an individual battery as a general proposition. Occasionally, when the target is in such position that to a specific observer his own battery fire is at right angles to the rest, then such an observer can differentiate, in all probability, between his bursts and the others because of the widely different appearance of fire viewed frontally and from the flank. Target practice is invariably fired from one position (necessarily so, for safety) and we must not for an instant lose sight of the certainty of multiple position firing in time of war, for which it does not appear possible to train in time of peace. The big guns occupy practically the same position, for the most accurate spotting and adjusting system is going by the boards in a general fort action unless a splash clock enables individual splashes to be singled out.

2. Should, then, batteries fire individually for purposes of adjustment? Most assuredly not! The target is fleeting and every second of its flight within range should be used by every battery in fire for effect. It is probable that the combined dispersion of three batteries is of greater value than the adjustment of one in producing hits in a minimum of time. Moreover, who shall say which battery of the three shall adjust on a target (assuming individual battery fire)? The battalion commander, naturally; but this assumes perfect communications between batteries and battalions and entails at the very best a dangerous waste of time in opening fire while waiting for fire orders from Battalion C. P. When one battery opens fire before the others, when due to a multiplicity of hostile planes the three batteries engage different targets, or when for one reason or another only one battery is available to engage a certain target, then the question of identification of bursts requires no solution.

The feasibility of adjustment of antiaircraft fire has thus been reduced already to a consideration of those cases where the bursts of individual batteries can be identified—cases which are expected to be decidedly in a minority in service firing. If adjustment shall be shown hereafter to be practicable, then even though it be usable in but one case out of one hundred, its development will be worth while. The remainder of this paper is based entirely on the assumption that the bursts are identifiable—the one case in one hundred.

There are certain details of technique that have been considered, if not a bar, at least a hindrance to adjustment:

1. One encounters first the familiar argument about adjusting on the setforward point or on the target. Prediction is made on some regular flight and if the target deviate from that flight during the predicting interval, then the deviations are meaningless. It will be shown later that a sufficient volume of fire must be put up to confirm thoroughly the deviations and prevent corrections based on a change in course of the target.

2. Deviations observed from the battery are only apparent. That is to say, if a burst occur behind the target, it is not necessarily a deflection error, but may be caused by a fuze burning too long, or if ahead, by a fuze burning too short. However, the disparity between the correct range and the range of the fuze must be far beyond that normally to be expected before this effect will be apparent. Generally an error in fuze range will produce so slight a deflection deviation as to be undetectable in the normal deflection dispersion of the battery.

3. Range deviations are not apparent from the battery. The maintenance of sufficient spotting stations so that one will always be a flank

station for fire from the battery is an impracticability. Both of these old contentions no longer hold. If a battery be serving at the front, then often the adjoining batteries will be flank stations, or flank stations may be established, time permitting, for the principal fields of fire. In rear areas there is no bar to the establishment of a complete network of spotting stations. Spotting from the flank is positive and is therefore to be preferred to any other form. It should be provided for whenever possible. The conditions under which flank spotting is impracticable will be in a majority, unfortunately, so that a system of range spotting from the battery must be devised and the solution is discovered in the stereoscopic range finder. When it is spceified that flank spotting is to be desired, it must not be forgotten that a self-contained battery (in which no distant stations are necessary) is an essential for antiaircraft operations in warfare of movement. While flank spotting is to be preferred, the development of spotting from the battery is more essential because it must be used more often. This paper deals only with spotting from the battery.

Before the details of fire adjustment become a concern of the battery commander, he first must prepare his fire thoroughly. The preparation of fire may be considered under the heads of mechanical adjustment, trial shots, and verification fire.

Mechanical adjustment is accomplished primarily by boresighting both guns and range instruments. With the method of boresighting on the sun an entire battery can be boresighted in, say, fifteen minutes. This operation should be performed at least once each day if the visibility of sun, moon, or stars permits. Periodical ballistic tests (that is, tests against firing tables) of the sighting and position finding systems should be made. In this form of test backlash and play will be made evident as well as any error in setting scales, cylinders, or pointers in the sighting and position finding apparatus. Fuze setters should be calibrated to set fuzes at the value read on the fuze dial. The careful accomplishment of these various tests and adjustments should insure that the battery enters fire in perfect mechanical adjustment.

Next in order comes trial shot firing. Volumes have been written on this subject and will continue to be written. Most of the discussion completely neglects the most important feature thereof—that the point of burst cannot be located with sufficient accuracy to justify any degree of refinement in trial shot corrections, except through the use of mirror position finders or camera obscura. We are losing our sense of proportion and computing to ounces from measurements accurate only to pounds. Pursuing this subject further, it is pertinent to examine into the causes of deviation from range table conditions. For concrete illus-

tration, the Model 1917 2600-f. s. gun will be used, at a point having a fuze range of 16 and quadrant elevation of 700 mils. The deviations will be considered in the natural coordinates of horizontal range and altitudes (see Firing Tables for 3-inch AA gun, Model of 1917, MK III fuze, MV. 2600 f. s.).

1. Probably all guns in service have lost from 50 to 100 f. s. muzzle velocity. The differential effect of this change is always negative. Suppose a 50-f. s. loss be assumed.

2. The wind effect is supposedly corrected for through the use of the wind computer. Actually the present wind computer does not furnish proper correction values according to the firing tables. When this fact is considered in addition to the possibilities of error in the meteorological message (or change since the receipt of the message) or in operation of the instrument and transmission of the corrections to scales absolutely unsuited for the application of the correction (the Model 1917 Data Computer) by operators too busy with principal deflections to occupy themselves therewith, it appears entirely reasonable to disregard the wind computer and absorb wind corrections through trial shots and adjustment. The wind effect is the smallest, in general, of the differential effects. For illustration, a range wind component of ten miles per hour will be used.

3. Imperfections of fuze construction will produce a certain range deviation, a general idea of the probable magnitude thereof being deducible from the firing table probable error in time of flight. This value is not the field probable error, but since fuzes are set carefully and checked in trial shot firing, it may be assumed that the firing table probable error in time of flight will be very nearly attained. Then, as a definite value, one time of flight probable error (0.16 sec.) will be assumed.

4. Density, of course, has a considerable effect on the flight of the projectile. A value of five per cent density change is not an unreasonable one to be used.

5. Any error in setting the quadrant elevation of the gun will have its differential effect on horizontal range and altitude. Since sufficient time is available in trial shot firing for laying the gun by gunner's quadrant, it will be assumed that this effect is negligible.

6. There is one further effect, the amount of which is unknown, but which would appear to be considerable, if the results attained in certain firings are to be credited. In these firings the guns of greatest service, and hence of lowest muzzle velocity, fired the farthest, as verified by mirror position finder records. There is no explanation for this unless it be that a change in muzzle velocity, through changing the

pressure under which the fuze train burns, produces a second differential effect in range. Thus, for a decrease in muzzle velocity, the pressure on the fuze train would be decreased, the train burn slower, and the projectile travel farther before bursting.

The differential effects corresponding to the ballistic conditions we have selected are:

DIFFERENTIAL EFFECTS, YARDS

	Horizontal Range	*Altitude*
50 f. s. m. v.	62	56
10 mi. range wind	48	8
1 P. E. in t.	41	13
5% density	91	74
quad. el.	0	0
m. v. effect on fuze	?	?

Following are all the combinations possible with the differential effects selected (m. v. effect must be negative always):

	Differential Effects, Yards		*Sense of Differential Effect*			
	Horizontal Range	*Altitude*	*M. V.*	*Wind*	*P. E. in t*	*Density*
1	—242	—151	—	—	—	—
2	—146	—135	—	+	—	—
3	+ 36	+ 13	—	+	—	+
4	— 64	—109	—	+	+	—
5	+118	+ 39	—	+	+	+
6	+ 22	+ 23	—	—	+	+
7	—160	—125	—	—	+	—
8	— 60	— 3	—	—	—	+

The burst is located by altitude, measured by the height finder, and horizontal range, computed from the altitude and angular height, the latter being measured by theodolite or B. C. Instrument. Errors are to be expected both in the determination of the altitude and of the angular height of burst. Even though the theodolite be used for angular height determination, the inability of the observer to locate the burst until after the wind has moved it considerably will cause appreciable errors. The exact magnitude of these errors is uncertain, but experience has shown that an error of 100 yards altitude, at the point chosen, is not at all exceptional and that the error is practically always negative. An error of 100 yards in altitude introduces one of 160 yards horizontal range (from firing tables). This horizontal range error is equal to or greater than the total of the differential effects except in the case where all have a retardent effect—and the additional error in horizontal range caused by an erroneous angular height reading has not been considered!

The error in altitude which has been assumed finds itself in almost as bad a position, being equal to or greater than most of the possible combined differential effects.

A concrete example has been used for illustration. The differential effects at any time may be greater, or they may be less than those used, and the error of altitude determination given is not an absolute value. However, this example, as well as continued experience with trial shot firing and investigation into the errors of locating the point of burst, will convince the student that we are certainly far from justified in correcting the quadrant elevation in units of 1 mil ($X = 4.5$ yards; $H = 5.6$ yards) or the corrector in units of 1 division ($X = 28$ yards; $H = 8.5$ yards) when the error in locating the point on which the corrections are based is certainly many times the value of those corrections. When we speak of applying a method of successive approximations to trial shot fire, we are rearing a handsome mansion on a foundation of mercury. When the scales won't weigh less than one pound it is manifestly foolish to deal in ounces.

What then, is the function of trial shots—if any? Essentially this—they will remove any constant error in altitude determination. When a stereoscopic height finder is adjusted on a ground target it is not necessarily adjusted for an aerial one; and there is a very definite tendency to read altitudes too low both on bursts and sleeve targets, though not necessarily by the same exact amount in the two cases. This fact—and the manner in which the correction is accomplished—is illustrated by the following example: Trial shots have been fired at fuze 10 and a 10% range correction computed. A burst for verification fire is put up at fuze 10 and then + 10% applied to all correctors. When the firing data come from the data computer, it will be noted that the altitude, being low, resulted in a reading of only 9 or 9.1 for the fuze range, but the + 10% on the corrector increases this to 10 which is known to be correct.

Strange as it may seem (and doubtless it is heresy to say it) visibility has more to do with trial shots than ballistics, since the altitude determination, with stereoscopic height finders, varies materially with the visibility. Accurate trial shots are an impossibility with present materiel and we should bear this in mind when we make our computations. If a battery be firing constantly, the battery commander will know from his past adjustment results what corrections to apply should trial shot firing be an impossibility at the time, and very possibly his judgment will be of more value than his trial shot results.

Often because of lack of time, invisibility of the sun, or for other reasons, a mechanical check of the battery is not possible immediately

prior to the firing. Recently, for example, a battery commander took out to target practice three guns that had not been in use for four months, on a day when the sun was invisible. In this specific battery the target burst is first fired and all guns fire at command "Battery Right (Left)" in the manner practiced by the field artillery, thus enabling the burst of each gun to be definitely selected. The first problem made one wonder if the guns were indeed firing at the target burst. A judicious application of the screw driver to the lateral movable index and of arbitrary vertical corrections soon reduced the pattern and placed it on the target burst—just as the towing plane entered the field of fire, and a successful practice ensued.

Verification fire need not necessarily be fired at a burst, unless a range sensing to verify trial shot range corrections is intended. Any fixed target will suffice. A celestial body may be used since regardless of the distance to the target and of the altitude used, if the sighting system *function normally* the bursts should occur on the line of position and thus be apparent hits. This is of particular value at night when verification fire may be directed at the moon or a star without necessitating the cooperation of searchlights.

Verification fire will check the adjustment and operation of the entire battery except the deflection determining and applying mechanisms (the travel of a burst even in a high wind is not comparable to that of a plane). It is almost an essential in a Case III battery. Even though no mal-adjustment be detected thereby, it will enable the visible pattern to be reduced to a minimum and give considerable confidence to the battery commander.

Adjustment in range has been made possible, it has been stated, by the addition of the stereoscopic height finder. This instrument magnifies many times the power of depth perception of the human eyes and enables an observer to perceive which of two objects is the farther away. Thus, if a burst and a sleeve target fall in the field of the stereoscopic glass *at the same instant* the observer has a definite sense that the burst is farther away or closer than the target, hence over or short. The italicized words furnish the key to first principle of fire adjustment: Since range sensings cannot be made until the bursts are occurring on the line of position (the field of the stereoscopic instrument being small), the first concern of the battery commander is to adjust the lateral and vertical deflections until apparent hits are being obtained. It is proper, then, to examine first into the deflection deviations to be expected and their probable cause.

The appearance of a large vertical deviation is a definite indication of personnel error or mal-adjustment of materiel. Among the probable

causes are: Reading from the wrong set of graduations on the 1917 Data Computer; an error of 100 mils in applying vertical deflection; an error in setting fuze range on the fuze range disc, for example 9 instead of 19, or by some disarrangement of the vertical elements of the sight. An an instance of the last, one may invite attention to the weakness of the pointer link. Despite constant warnings, it will happen that a cannoneer will take hold of the pointer link to assist himself in mounting the 1918 carriage, thus bending it and causing the corrector pointer to take a false position with a corresponding direct effect on the quadrant elevation of the gun. Large vertical deviations might be caused by large range errors without altitude error to produce a vertical deviation effect, but this condition is practically unknown in actual occurrence. Note that an altitude error, alone, will not cause a deviation effect, since range and super elevation are both determined from the same source (angular height being common to all instruments and sights) and the position finding effect is to place bursts on the line of position regardless of altitude. Generally speaking, if the vertical deviation is 10 mils or more, an effort should be made to detect the source of the error rather than attempt to adjust it out, since a personnel error of that magnitude will probably remove itself in the course of the fire and correction therefore would reproduce the deviation in the opposite sense.

Small vertical deviations may be produced by any of a number of personnel or materiel errors or ballistic causes. Generally they are of such nature that they are approximately constant and adjustments in 5-mil, and occasionally 2½-mil units are warranted.

Large lateral deviations, as well as vertical, are traceable directly to personnel error or materiel failure. From personnel causes, it is to be expected that the wrong set of graduations has been used in reading from the 1917 Data Computer or that an error of 100 mils has been made in applying the deflection to the sight. In either case the gun commanders should be trained to sight along the line of metal prior to the first shot to verify the reasonableness of the pointing and thus prevent any gun being fired with a large lateral error existing. The most general materiel cause for large lateral errors is that the Data Computer is not furnishing correct deflections. With the 1917 Data Computer, this is generally traceable to the hardening and cracking of the leather faced disc, in which case neither correction nor adjustment can be expected to produce satisfactory results. A large range error, whether or not caused by an error in altitude, will produce an apparent lateral deviation, a long over being behind the target, and vice versa. It is unusual that a range error sufficient to produce this

effect noticeably will be encountered in practice. When lateral deviations of about 20 mils are noted, the battery commander should endeavor to determine the cause of the error rather than to adjust.

Lateral deviations smaller than about 20 mils may be produced by innumerable personnel, materiel, or ballistic causes. Gun pointers' errors will cause irregular deviations. Constant deviations are to be expected from incorrect ranges, as mentioned in the preceding paragraph, and from incorrect wind and drift values as well as through incorrect deflection values from the data computer. The lateral center of impact should be adjusted on the target, the adjustment being made, generally, in 5-mil units and occasionally in 2½-mil units.

The magnitude of the deflection deviations may be estimated by eye, measured with field glasses, or by a B. C. Telescope. Certainly some form of measurement is to be preferred. It must be remembered, however, that under conditions of poor visibility or with targets at long range, it requires considerable time to locate a sleeve target in any glass. Whether the Battery Commander or the Range Officer be adjusting the deflections, there are too many details requiring their attention in the battery at the time for opening fire to permit them to concentrate on locating a target. Yet if they search for the target after the opening of fire it may be not located until the conclusion of the course. One solution is to have an observer following the target at all times with a B. C. telescope and have the adjusting officer take the telescope from the observer at the time desired. A further solution is the design of the new B. C. Telescope with a double eyepiece, so that the adjusting officer need not concern himself with operating the instrument at any time.

Sufficient bursts must be permitted to occur that adjustment will not be made on gun pointers' errors or change of course of the target but that a true C. I. will be established. Correction for the full deviation of the C. I. as "Right (left) so much" called off by the adjusting officer is applied by the chief of range section, who reaches over to the data computer and applies the values personally. Under no condition should it be expected that the lateral and vertical deflection readers of the 1917 Data Computer, in addition to their regular duties, are capable of overhearing and applying the correction values without error. Note here that we have complementary term and adjustment both being applied to the same vertical scale—a natural cause for small error which should be guarded against, in so far as possible, by careful training. The 1917 Data Computer is not well designed for adjustment.

Large range errors are caused almost exclusively by errors of altitude, whether those errors be of determination or in application to the data computer. They may be caused by an error in transmitting or receiving the fuze range at the guns or by mal-adjustment of the fuze range drum of the data computer. Small range errors may be produced by any of the above, by the many ballistic causes affecting the flight of the projectile, or by variations in the dead time. Errors in transmitting fuze range may, it is true, eliminate themselves or be detected. In general, however, if a range deviation is noted it must be adjusted for without attempt to detect the source thereof until after the firing.

A mathematical proof has been advanced to show that the greatest probability of hitting occurs when the C. I. is 50 yards short of the target. This proof is based on a firing table lateral probable error. Because of the considerably larger lateral probable error to be expected in the field, it is essential to place as many hits as possible in the plinth of the figure representing the inverted explosive shell volume, since the permissible lateral deviation here is 50 yards, as contrasted with nine yards at a point 50 yards short. Moreover, the stereoscopic observer cannot judge correctly the amount of a deviation, but only its sense. The aim of the Battery Commander should be the C. I. (range) on target, but of this he cannot be sure. His only positive indication of an approximately correct range is when he notes mixed overs and shorts on the same course. That, then, is the aim and limit of fineness of range adjustment—mixed overs and shorts.

In detecting overs and shorts, the stereoscopic instrument is reasonably efficient. In a recent series of firings, spotting was attempted on 210 courses. Sixty-one of this number were lost due to wide deviations, smoke, poor visibility, and for other reasons. Of the remaining 149 courses on which spotting was attempted, 112 (75%) were correctly sensed. Of the 37 courses where errors in sensing were noted, only five were absolutely wrong, that is, called "all short" when, in fact, all were over. On the remaining 32 the sensing was "overs and shorts, mostly over" when in fact it was mostly short, or in error in some such fashion. This brings to attention another point. Bear in mind that the stereoscopic observer notes only those shots absolutely correct for deflection, and his reports, therefore, are not based on every burst. It is exceedingly dangerous to attempt to change on a majority of overs or a majority of shorts. If any contradiction is obtained, even though a majority be in one sense, experience has shown that no change is warranted. One cannot specify "an equal number of overs and shorts" as the aim of adjustment.

Having determined that a range change is desirable, then the correction should be made in that value primarily responsible for the production of the deviation, namely altitude. There are three essential reasons why this should be done: First, because it is logical to correct where the error enters; second, because an altitude change alters the range without changing the bursts from the line of position, to which they have been moved by deflection adjustments; and finally, because it is not practicable to change the corrector on the fuze setter during fire nor to apply a correction to the fuze range index of the data computer with present materiel, so that a pure range correction is impossible.

With regard to the amount of altitude change to be made (the amount of deviation, be it remembered, is unknown) experience only will dictate. With a certain sterescopic observer, it has been learned that his large altitude errors were approximately constant and were absorbed by trial shots. Thereafter his probable error of altitude determination was of the order of 1% and this was used as the correction increment, with satisfactory results.

The correction should be made during the conduct of firing on the course where the observations were made, for with a new course new altitudes are read and new chances for deviation creep in entirely unrelated to the preceding course unless the error of altitude determination remain the same. This is not often practicable unless the fire be deliberately slowed down for the purpose—a proceeding not to be tolerated in time of war. Consider the 1917 gun firing 25 rounds per gun per minute, which is not excessive for a well drilled crew. When firing with a time of flight of 16 seconds (which is rather short than long) a 4-gun battery will have some 27 shots in the air before a burst occurs. Then, allowing the occurrence of about three bursts per gun for the determination of the lateral C. I. and, say, two more for the application of a correction, 47 shots have been fired before range spotting begins. The battery commander will be fortunate if his range C. I. is developed and the deviation thereof corrected for in under 60 shots—almost a full practice allowance. Range corrections have been applied successfully during firing with one gun and it has been proven possible for service firing conditions with four guns.

In considering the method of applying the correction, it must be realized that the stereoscopic height finder cannot be stationed at the B. C. station, generally, because the smoke, dust, and heat waves of the guns prevent efficient operation of that instrument. The Battery Commander cannot station himself on the flank with the height finder, since he cannot properly supervise the battery from that distance. This

prevents application of altitude corrections on the percentage scale of the height finder and dictates that they be applied in yards at the data computer, during the firing, since the battery commander himself must accomplish the range adjustment. If a transmitter be attached to the height finder convenient to the observer, he can call his deviations by phone, the receiving headset being worn by a detail standing by the battery commander or by the battery commander himself.

It appears best that all adjustment be concentrated in the battery commander, who observes the deflection deviations personally and receives range deviations by phone. The deflection corrections should be applied by the chief of range section and the altitude corrections by the range officer.

In summation, then, the deflections must first be corrected to make range sensings possible and the range then adjusted by altitude changes until mixed overs and shorts result.

In target practice, strange to relate, we are prone to lose sight of our primary mission and shoot for hits per gun per minute exclusively. We shut our eyes on the hostile planes and aim at a figure of merit. It has been advanced that if the battery commander decreases the altitude read by, say, 50 yards, and creep his altitude from —50 to +50 during a shoot he would be positive of one group of hits in each course —but his percentage of hits and hits per gun per minute would fall off. Altitude, and through altitude, range, is the great difficulty. Why not devise a scheme that would absorb the altitude errors and increase the probability of hitting at least once at the expense of the percentage of hits? Say what you will, the practice that produces one hit on each of five courses is infinitely more to be desired for service firing than the practice that attains no hits on the first four courses and twenty on the fifth. Successful adjustment is exceedingly difficult. Let's obviate it by intelligent dispersion.

The dominant type of army today is the nation in arms.—*Frank Taylor, in The Wars of Marlborough.*

A Suggestion for a New Method of Locating Aircraft at Night

By CAPT. WILLIAM SACKVILLE, C. A. C., and LIEUT. J. E. OLIVARES, P. S.

Second Prize (Tie), Annual Prize Essay Competition

THE need for improving the present method of locating aircraft at night has long been apparent. Many ways have been devised and many theories proposed as to the best method of meeting this need, but none of them can claim to be entirely satisfactory. The fundamental error seems to be that they take cognizance of the need for improving the present instrument operating on sound rather than in recognizing the actual need of developing an entirely new apparatus based on other than the slow-moving sound wave.

Science has made tremendous strides during the last few years and there is no reason why we should not make use of these new discoveries to evolve a method which will best solve our problem. Based on these great advancements, we have made an analysis of the problem of locating aircraft at night, and herein we shall endeavor to make clear the conclusions which we have drawn.

REQUIREMENTS OF AN INSTRUMENT FOR DETECTING AND LOCATING AIRCRAFT AT NIGHT

In any definite problem there is always an ideal which we should strive to attain. Human nature, however, is so inadequate that this ideal can not always be reached; consequently, the solution that can best approach the optimum must of necessity be the end to strive for. To our mind the ideal instrument for locating aircraft at night must fulfill the following requirements:

It must be instantaneous in action; that is, the disturbance caused by the plane which actuates the detecting instrument should not take any appreciable length of time to travel from the plane to the detector. The signal produced by the detecting instrument should activate the detecting sense to a maximum degree. The instrument must be accurate in its location of the plane position and capable of following it. The range at which it is able to detect must be a maximum. It should be sensitive to the disturbance created by the plane only and insensitive to all outside disturbing agents. The instrument must be

able to distinguish between planes of a group at all times so that there may be a means by which the Battery Commander can "check" on the plane being tracked. It should eliminate the use of the searchlight so as to gain the advantage of surprise on the enemy. Finally, it must be portable and of rugged construction in order to withstand service conditions, and must have a minimum of adjustment so that it may be operated by the average enlisted man.

POSSIBLE METHODS BY WHICH A PLANE MAY BE LOCATED AT NIGHT

Assuming that we have a plane in the air at night, the question is, what means have we available for locating its position? First, there is the disturbance in the air created by the propeller and the detonations of the exhaust which produce sound waves that may be used as a means for detection. Then there is the electric disturbance in the ether created by the ignition system of the engine which causes electric waves to be propagated through space and thus become an agent for detection. Also, there is the power dissipated through the exhaust in the form of light or visible rays and infra-red or heat rays. These rays may also be used as a means for detecting the presence of the plane.

The sound wave, as a means for detecting airplanes at night, is the basis of the method now in use. It has the advantages of great volume and simplicity and ruggedness of construction. Against these, however, may be urged the following disadvantages: Sound travels at the rate of 1100 feet per second; consequently, it takes an appreciable time to reach the receiving apparatus so that the wave front actually received started at a point which is at a considerable distance from the present position of the plane. This is called time lag. Furthermore, the velocity of the wind affects the speed of both the sound waves and the plane, causing a further deviation in the located position. This is called wind lag. These deviations, which are not susceptible of accurate prediction and correction, make it impossible to locate the plane accurately. Moreover, due to the fact that there are no means of knowing that two receiving apparatus are on the same plane of a group, firing data can be obtained only through the use of searchlights. This is a decided disadvantage, as it reveals to the enemy our own position.

It is a well known fact that the ignition system of a gas engine acts as a spark gap transmitter producing radio waves which are propagated through space by the leads from the distributor to the spark plugs, acting as antenna. The action is as follows: The condenser across the breaker points, in conjunction with the breaker points and the primary of the induction coil, produce radio frequency oscillations in the primary circuit. This action induces radio frequency oscillations

in the secondary coil, which is in series with the spark and the leads to the spark plug. In effect, we have a radio transmitting set which radiated energy through space as explained above. Dr. G. W. Pickard states that during his experiments on the polarization of short radio waves, he experienced interference from passing airplanes. He estimated that the signals from an airplane engine could be received at a maximum distance of one mile. By using the directional properties of coil antenna it is possible to obtain the azimuth of the plane. However, since its unidirectional property depends on the symmetry of the coil capacity to ground, the location of the plane in elevation would be difficult of determination. This method has the advantages of (1) the speed of the radio wave, which would eliminate time and wind lag; (2) ease of detection under unfavorable weather conditions; and (3) comparative simplicity and ruggedness of construction. The disadvantages are the interference from other radio signals, due to the fact that the wave lengths emitted are in the band included between twenty and forty meters, and inability to locate the plane accurately. Furthermore, the greatest disadvantage is the facility of shielding the leads so that the energy emitted would be such as to limit the range to a minimum which would be entirely inadequate as a means for defense.

Vision, used as a means for detecting airplanes, is the method par excellence. If it were possible to use the method of vision at night, the problem would literally solve itself. There is a possibility of using this method, as the exhaust actually emits flame visible at night, due to the presence of incandescent carbon particles therein. The range at which the flame is visible is limited, but by using a telescope it may be increased. However, this stream of flame, being limited in length, may be easily obscured from view by shielding.

The heat waves emitted from the exhaust of the plane would be a convenient means of detecting and locating its position if a sufficiently sensitive device were available for this purpose. These heat waves have the speed of light; hence time lag, which is so objectionable in the present method based on sound, would be eliminated. The wave, being electro-magnetic, is not deflected by the wind; consequently, there is no wind lag. The above being true, the plane may be accurately located, and by employing two detecting instruments at either end of a base line, firing data may be obtained without the use of searchlights. Moreover, by the use of selective detectors which make use of the periodicity of impulse of the exhaust, a means is available to ascertain whether or not the two instruments are on the same plane. One disadvantage of this method lies in the fact that the exhaust may be

shielded to a certain degree, but this shielding is limited by the loss of efficiency of the engine. Considering the fact that the defense is primarily against bombing planes with heavy loads, the engine efficiency can not be greatly reduced without materially limiting their offensive value.

Of the four methods described above, those by vision and radio waves may at once be eliminated, as proper shielding would reduce the obtainable range to such a degree that the defensive value would be negligible. The problem therefore reduces itself to a choice between sound and heat waves as a means of detection. From a consideration of the previous discussion of these two methods, the following points may be evolved: Sound will locate the approximate position of the plane only, while the heat method would give an accurate location. Moreover, the heat method has the advantage of selectivity mentioned above, whereas sound does not. Under these considerations it would be possible, using the heat method, to make an accurate track of the plane and obtain firing data without the use of searchlights, thus gaining the advantage of surprise on the enemy. A comparison of the maximum ranges of the two methods, which is of primary importance, can not at present be made. However, granting that sound would give the greater range, the combination of the two methods would still allow the searchlights to be eliminated, as the heat method would take its assigned mission of tracking the plane, thus obtaining firing data under the cover of darkness. For the above reasons and the fact that the sound method has not been a complete success, the method using the heat radiation from the exhaust has been selected for the solution of this problem.

INSTRUMENTS WHICH MAY BE USED FOR DETECTING HEAT RAYS

Just as the eye is susceptible to the sensation of vision, so do we have instruments that will detect as small a temperature change as a millionth of one degree C. Heat energy, being invisible, requires the use of instruments which transform this invisible radiation into some other form of energy, the effects of which can then be detected. Various instruments of this kind have been devised, most important of which are the radiometer, radiomicrometer, bolometer, thermopile, and photo-electric cells.

The radiometer, which is extensively used in infra-red investigations, is a very sensitive instrument, but, due to its susceptibility to the slightest vibration, it is necessary to isolate it from all possible mechanical vibrations during the progress of an investigation. This makes it so delicate an instrument that its use is restricted to the laboratory.

The radiomicrometer, which is in effect a moving coil galvanometer, is as sensitive as the radiometer, but it has the same disadvantage in that it is too delicate an instrument to be used under service conditions.

The bolometer is a more rugged instrument than the two previously mentioned, but it requires a very elaborate installation and is difficult to keep in adjustment. It is not therefore an entirely satisfactory instrument for field use.

The thermopile is the simplest type of instrument for detecting heat rays. It is quite rugged and may be made as sensitive as any of the above instruments. It has already been employed for the detection of heat energy from the exhaust of an airplane. In 1919, Samuel O. Hoffman used a Crosshair thermopile, the separate elements of which (vertical and horizontal) were separate piles of thirty-two couples each, electrically insulated from each other and connected to separate galvanometers. The thermopiles were placed at the focus of a twenty-four inch mirror provided with slow screw movements in azimuth and elevation. A plane, developing fifty horsepower, was tracked at a range of two thousand yards, and an average galvanometer deflection of ten centimeters was obtained. However, the warmth from clouds drifting across the field of view of the instrument produced deflections in the galvanometers of the same order as those of the plane, but without the abrupt jump which characterized the start of the deflection produced by the plane.

The disadvantage of using delicate instruments, such as galvanometers when a thermopile is employed, may be overcome if a triode valve and telephone be substituted for the galvanometer. By placing an interrupter in series with the thermopile and primary of a step-up transformer, the pulsating voltage induced in the secondary may be impressed on the grid of the first tube of an amplifier, thus making it possible to detect the thermopile current by means of a telephone. This arrangement would give the further advantage of greater sensitivity. The chief disadvantage of the thermopile, however, is its nonselectivity as it does not distinguish between the heat radiation from the exhaust of a plane and any other source in so far as concerns detection. However, if a quartz shield were placed in front of the sensitive material of the thermopile which would allow the short heat rays of the hot exhaust gases to pass through, but would absorb longer heat rays from clouds and other extraneous sources, this disadvantage would be minimized and the method would be of extreme value.

The extreme selectivity of photo-electric cells give them a decided advantage over any other type of instrument that may be used for detecting the heat radiation from the exhaust of an airplane. If the

cell used has a maximum sensitivity in the region where the energy distribution curve of the exhaust gases is a maximum, we would have an apparatus that would be very sensitive to the heat radiation from the plane. In addition, any other source emitting radiation of wave lengths greater or less than those emanating from the exhaust would not be detected by the cell. Moreover, since the heat is radiated in periodic trains corresponding in frequency to the periodicity of impulse of the exhaust, if the cell could recover its resistance between these periodic trains, the output of the cell would have the same frequency as the number of impulses of the exhaust; and the advantage, previously mentioned, of having a means to ascertain whether or not two instruments are on the same plane, would be gained.

THE PROBLEM OF RANGE

The products of combustion in the exhaust of an airplane consists of water vapor, carbon dioxide, carbon monoxide, and incandescent carbon particles. Water vapor, carbon dioxide and carbon monoxide produce radiations which are readily absorbed by the atmosphere. This abnormal dissipation reduces the range obtainable from their radiations to a minimum. The incandescent carbon particles produce most of the visible flame emitted from the exhaust and at the same time are sources of black body radiation. The emission spectrum of this radiation, which is a maximum at about 1.3 to 1.8 U, depending on the temperature (the red end of light is .75 U; U $=$ 10^{-4} cm.), is supposed to be smooth and continuous; hence it is not so readily absorbed as in the case of the gases. We must therefore depend upon this black body radiation in order to obtain maximum range for detection.

Due to the dissipation of energy in black body radiation, which is believed to be inversely as the square of the distance, the range obtainable is limited. By employing a collecting apparatus for concentrating the rays, such as a parabolic mirror, this limited range may be increased considerably. The collected rays or amount of energy received would then vary as the area or, in other words, directly as the square of the diameter of the mirror. The choice of dimensions of the mirror is governed by the sensitivity of the detecting instrument placed at its focus and also the mission assigned. After the ultimate sensitivity of the detector has been attained, the only means of increasing the range is by increasing the size of the mirror. On the other hand, its portability must be taken into account. If it is to be used for fixed defense, the mirror may be made as large as desired, consistent with ease of operation, but if it is for field use, its portability must necessarily limit its size. This material of the mirror must also be con-

sidered. The surface must have a minimum of absorption for the wave lengths of the rays to be reflected. Measurements of the reflectivity to infra-red radiation by various metals have aided the choice of suitable materials to be employed. Highly polished metallic mirrors give good reflection for wave lengths in the neighborhood of 1.3 U to 1.8 U. Platinum or silver electro-deposited on a glass surface, on account of their high resistance to the corrosive action of the atmosphere and their high reflective power, are also suitable for this purpose.

CONCLUSION

Improvement should never end. With this idea in mind a suggestion is given for locating aircraft at night using the heat method. By employing a selective detector for changing the incoming heat energy into electrical energy and stepping it up by means of radio amplification, we have an apparatus which would appear to fulfill every requirement for an ideal instrument for this purpose.

APHORISME XXVI

The law of Armes tolerates a professed enemie to attempt that by strategem, fraud or suborned treacherie, which cannot bee atchieved by force, without long endeavouring, uttermost danger and excessive charge. But it is dangerous for a Generall to treate in such a practice, and bee of the party, if hee bee to ingage his person and trust his life in the hands of the suborned traytors; lest whilst he seeks to buy other mens lives for money, he sells his owne for nought.—Ward's Animadversions of War *(London, 1639).*

Military Policy of the United States*

By LIEUT. COL. C. B. ROSS, C. A. C.

FREQUENTLY we hear made the statement that this country has no military policy. Such a statement either is a misrepresentation, or at least an exaggeration, by one who for some reason or another is not in accord with that policy, or it is the result of confusing two different things.

It is true that not until a few years ago did we have any systematic plan for carrying out our military policy. It is true also that we do not very consistently follow that plan now that we have it. It even may be true that the plan itself leaves something to be desired. However, by none or all of these things is our military policy annulled or even altered.

To form a clear idea of our military policy it is necessary to keep constantly in mind the mental attitude of the founders of our government. This was partly the result of natural temperament and partly the result of experience.

While the original population of the colonies was not exclusively Anglo-Saxon, it was predominently so and the government that was formed after independence had been won was a government built on Anglo-Saxon ideals and experience.

Deeply fixed in the Anglo-Saxon mind is the belief that a standing army is a dangerous menace to liberty. This is sometimes referred to as a foolish fear. It is not a foolish fear. On the contrary, it is the result of many generations of experience. However, the fear is exaggerated out of all proportion to the menace because of the fact that those who hold it fail to differentiate between an army subject to the will of a tyrant and an army at all times subject to the will of a free people.

In any event, the founders of our government, bearing in mind that one of the reasons why they had left their homes in Europe was to escape from oppression exercised through armies and placing the blame for that condition on the armies themselves rather than on those who controlled the armies, took particular care in framing the constitution to place the military power in a position subordinate to the civil power in time of peace. The military power, under our system, is supreme only when through some emergency the civil power is unable

* Lecture to the R. O. T. C., Fordham University.

to function. In such case martial law is declared and the military retains control until such time as order is restored and the civil authorities can resume their normal functions.

Another evil that developed during the life of the colonies, an evil that had a marked influence in the determination of our military policy, was control by a central government far removed from local conditions and with little, if any, knowledge of those local conditions. This evil also the founders were determined to remedy. In fact, the first attempt at union after the Revolutionary War was a very loosely held confederation of entirely independent states. Even after that plan had been demonstrated a failure it was only with the greatest difficulty that our present constitution, including the bill of rights contained in the first ten amendments, was adopted. It encountered the most bitter opposition from those who held that it placed too much power in the hands of the central government.

It was because of this double fear, that of an oppressive militarism and that of a too strong central government, that control of the militia was retained by the several states and the use of the militia by the Federal government was restricted to three purposes: "To execute the laws of the Union, suppress insurrection, and repel invasions."

Even in the World War such National Guard regiments as saw active service were first mustered out of the service of their respective states and were then mustered into the service of the United States. They, therefore, ceased to be a part of the militia and became a part of the army of the United States. Each individual officer and enlisted man so mustered into the Federal service was a volunteer. The same was true of such National Guard regiments as saw service in Cuba, Porto Rico, and the Philippines in the Spanish-American War.

It is upon this mental attitude of the American people and upon these express provisions of the constitution that our military policy has been built. That policy never has been formally reduced to writing, but it is a definite part of our unwritten law and it can be summarized in very simple terms.

We are to have a complete civilian control of the military. The President is the Commander-in-Chief of both the Army and the Navy. He exercises his command through the Secretaries of War and Navy, both civilians, both of whom are appointed by him, and both of whose appointments must be confirmed by the Senate, whose members are representatives of their various states.

We are to have a small Regular Army, no larger than is absolutely necessary to accomplish its three-fold mission. It is to care for sudden, minor emergencies. It is to be the skeleton on which the real army of

defense is to be built. It is to furnish a corps of commissioned and enlisted instructors for that larger army, both before and after the emergency has presented itself. In order to accomplish this three-fold mission the Regular Army must be brought to and maintained at the highest possible state of efficiency, regardless of its strength as fixed by Congress from time to time.

To furnish the first line of defense in a major emergency, the Regular Army must be reinforced by the National Guard, or Militia, a body of organized, partially trained, and thoroughly equipped troops which can be quickly brought into service. This auxiliary force is to be of sufficient strength, theoretically at least, to give the regular army sufficient support to hold the enemy while the citizen army is being mobilized, equipped, and trained.

That summarizes our military policy. The theory on which it is based is that every citizen owes the duty of protection to the country that protects him. It gives full recognition to the fact that the total protection any country can give its citizens is the algebraic sum of the protection the individual citizens give their country. That fact should be self evident to everyone. Unfortunately, it does not appear to be self evident to a certain proportion of our people who are making themselves distinctly audible at this time.

Whether or not this is a desirable policy from a strictly military point of view, whether or not it is the best policy to secure the safety of our country, are matters entirely beside the point. It is the policy to which our country stands committed and the policy to which it probably always will stand committed. It is the policy to which all means of national defense must be adapted.

There is no question but what a proper means of national defense can be evolved from this policy, but it should be obvious that in order to accomplish this end there must be at all times ready a thoroughly worked out plan for mobilizing, organizing, and equipping the citizen army which will be called into being for a major emergency. It should be equally obvious that unless we are to place a totally untrained army in the field, as we have so frequently done in the past, we must have the means for training at least the officers and key enlisted men of this citizen army in peace time. It is upon these emergency officers and key enlisted men that the training of the bulk of the citizen army will fall. If they themselves are untrained they cannot undertake the task. That means a loss of time until they can be given at least a measure of intensive training.

It has been in that failure to provide for proper advance training that our country has failed to put its known military policy into proper effect.

We always have confused military resources with military strength. It takes time to transform iron in the mines into guns on the battle field; and it takes time to transform professional and business men, clerks, artisans, and farmers into soldiers. Some years ago we heard much from a very prominent American about a million men springing to arms between sunrise and sunset. As a matter of fact, both prior and subsequent experience demonstrated that they wouldn't do anything of the sort. Further, experience has demonstrated that, even though they did so, they would be valueless as soldiers until they were trained, valueless then also unless they had in hand arms and other equipment with which to work. In the World War it took nine months to get our first division into the line. And that was a Regular Army division.

We always have had a very exaggerated idea both of the fighting ability of our people and of the disinterested patriotism which led them to do it. This has been fostered by our popular historians, who always have magnified the exploits of our armies and minimized those of the enemy. The average American seems to believe that if only one of our soldiers looks sufficiently fierce at least ten of the enemy will run away. If that were only true it would simplify things greatly, but it never has been demonstrated. On the contrary, any force of trained troops will always defeat a greatly superior force of untrained troops.

True, both the Civil War and the World War were won by armies of emergency troops, but at the time they began winning they had been in the service long enough to give them the amount of training that regular troops would have had. And it is rather appalling to think of the needless loss of life that went before.

Granted, we never have lost a war, but we have lost many battles and in every case it was because we were expecting untrained troops to do the work. We like to think that Americans fight to the last, never retreat, and never surrender. If we wish to keep on thinking that we must carefully avoid reading history. To take only one example, at the battle of Bladensburg in 1814, 5400 untrained Americans—or at least only about 1000 were regulars—were routed and put to flight with a loss of only eight killed and eleven wounded by less than 1500 trained British troops. They ran, and they didn't stop running until they were sixteen miles beyond Washington, which it was their mission to defend. It took three days to reassemble them, and meanwhile the British had burned Washington, after which they returned unmolested to their ships.

These men were good, average Americans, and were as capable of rendering good service as any other Americans. What they lacked was training and efficient officers. There was not the slightest excuse for this defeat, as it had been known for nearly a year that a British fleet with 3000 troops on board had been hovering along the shores of Chesapeake Bay with Washington as its probable objective.

The first logical step taken by Congress toward definitely organizing for national defense was in the passage of the Militia Act, sometimes referred to as the Dick Law, in 1903. This act was passed under the constitutional provision which empowers Congress "To provide for organizing, arming and disciplining the militia and for governing such part of them as may be employed in the service of the United States, reserving to the states respectively the appointment of the officers and the authority of training the militia according to the discipline prescribed by Congress."

Under the provisions of this act "Federal recognition" of National Guard officers and of National Guard units is provided for in the case of such officers and units as attain a certain standard of proficiency under the instruction of such Regular Army officers as are detailed by the War Department to give the prescribed instruction. These officers are known as inspector-instructors. They perform exactly the duties that their title indicates. They instruct officers and enlisted men of the National Guard in accordance with the detailed plans of the War Department, and they report to the War Department on the progress of that instruction. Their function is purely advisory. They exercise no command and they have no voice in the selection or promotion of officers. Under the terms of the constitution both of these are distinctly state functions.

National Guard units and officers, attaining and retaining the required standard of proficiency and, accordingly, federally recognized, receive direct benefit from appropriations for the National Guard by Congress and are eligible for immediate muster into the Federal service in the event of an emergency declared by Congress. Units and officers not federally recognized are not so eligible to derive benefit from Federal appropriations and they must undergo further training prior to muster into the Federal service. At the present time the great majority of National Guard units are federally recognized. Many individual officers are federally recognized and many are not. Federal recognition of the unit does not carry with it automatic Federal recognition of the officers assigned to that unit. Each must undergo examination and demonstrate his fitness before such recognition is granted him.

The Dick Law has accomplished two things. It has provided a

uniform standard toward which the training of all National Guard units of all the states is directed and it has caused a material improvement in that training. In the case of certain states, where the National guard was little, if anything, more than a means whereby certain individuals sought political or social preferment, the improvement has been very marked. It did not correct what, from a strictly national defense point of view, is an undoubted weakness. Complete control of the National Guard, together with the actual conduct of all training, is still in the hands of the various state authorities.

An extreme illustration of the evils connected with such a system was given some years ago when Governor Blease of South Carolina mustered out of service the entire National Guard of the state a short time before his term of office expired, and there was no agency with the authority to prevent his doing so or to reorganize the National Guard until the new Governor assumed office. That this probability will not occur again does not alter the fact that it is an ever-present possibility, and it might occur on the eve of a grave national emergency. Also, some Governor with considerably more than the few days that Governor Blease had to serve might decide to do something of the sort and thereby seriously imperil the national defense.

Another factor which may or may not be an evil, this according to the dispositions toward the National Guard of the various governors, present and future, is the fact that the War Department, except in so far as it can withhold recognition, has no control over the officers of National Guard units. A unit under efficient officers may be brought to a high standard of efficiency and then conditions may cause the separation of all these officers from the service, to be succeeded by others totally inefficient. The enlisted men as a team probably would be able to function for a considerable time after the change, yet if conditions should make it necessary for the unit to be called into the Federal service during this time, it would have to take the field under entirely strange officers.

Of course, the answer to that is that the occasions when a National Guard unit would be required for Federal service are few and the occasions when it might be required for state service are many; therefore, control in peace time should be vested exclusively in the state authorities. That very likely is true and I have no desire to question the wisdom of the constitutional provision that prescribes this. However, we are now considering the matter purely from the national defense standpoint and as a feature of our military policy. When so considered it must be admitted that the National Guard would be a more effective

weapon if it were a Federal organization functioning directly under the War Department.

The Dick Law was the first step in the history of our country toward the formulation of a definite plan for the carrying out of our military policy. The next step was the National Defense Act of 1916, which was amended and amplified by the National Defense Act of 1920. Just as the Dick Law provided for organizing, equipping, and training the National Guard, so the National Defense Act provides for organizing, equipping, and training the citizen army, which is the force which, in the last analysis, our country always must rely for its defense. This citizen army is known as the Organized Reserve. For the first time in our history, provision is made for the building up in peace time of a reserve organization whose sole mission is national defense and which is under Federal control.

The National Defense Act provides for an Army of the United States. Do not confuse the two terms. When the term United States Army is used it is the Regular Army that is referred to. The term Army of the United States refers to the three-part army, composed of the Regular Army, the National Guard *when in the service of the United States,* and the Organized Reserve. It provides for an Officers' Reserve Corps, an enlisted Reserve Corps, the Reserve Officers' Training Corps, and the Citizens' Military Training Camps.

Under the provisions of this law, continental United States is divided into nine corps areas, each with approximately the same "military population." To each corps area there is assigned one Regular Army division, or reinforced brigade so organized that it may be expanded into a division, and two National Guard divisions. These three divisions, together with certain corps and army troops that are not assigned to divisions, constitute that corps area's quota of the first wave. The nondivisional units are organized in part from the Regular Army, in part from the National Guard, and in part from the Organized Reserve. These nine corps of the first wave are to be organized into three field armies and consist of approximately 1,250,000 officers and men.

Similarly, in each corps area there are organized three divisions with appropriate corps and army troops for the second wave, which consists entirely of Organized Reserve troops to be mobilized from three to six months after the first wave.

The paper organization for the Organized Reserve is to consist of a full quota of officers and for each unit a cadre of enlisted men consisting of the noncommissioned officers and enlisted specialists.

Provision is made for giving inactive training to all officers and enlisted men and training in an active duty status for fifteen-day periods as frequently as appropriations of funds by Congress will permit, not to exceed fifteen days each year.

The systematic carrying out of this plan, which is clearly set forth in detail, will give our country an adequate national defense, and when the law was finally adopted by Congress in 1920 it was believed that this was the absolute minimum that would accomplish this end. Unfortunately, the plan has no automatic player attachment. It cannot operate without appropriations of funds, and appropriations have dwindled annually until we now have only about forty per cent of the Regular Army and National Guard contemplated and the training of Reserve officers and enlisted men has fallen far behind. Further, appropriations for the R. O. T. C. and the C. M. T. C. have been materially curtailed. It would appear that we are again approaching that condition of almost total unpreparedness in which the beginning of every war in our history has found us.

We have the policy and we have the plan, but if we observe neither we might as well have neither.

APHORISME XVIII

In the honour of great achievements, inferiour Officers and Souldiers partake with the Generall, according to the measure of their place and merit: but the well or ill ordering of things atchieved, redounds wholly to his own proper glory, or shame: it behooves him therefore to have a speciall care to the safety of his Army, that every-thing may be regulated according to rule and order; for it is greater honour to come off with judgement, than to goe on with courage; to use victory wisely, than to get it happily; and more glory to retain that which is wonne victoriously, than to obtaine it.—Ward's Animadversions of War *(London, 1639).*

A More Effective Danger Volume for Antiaircraft

By First Lieut. J. E. Reierson, C. A. C.

IN the February, 1926, number of the Journal, the writer described a method of artificial gun dispersion, having three centers of impact in a horizontal plane at intervals of sixty-five yards in horizontal range. This article will give the steps necessary to place four centers of impact in a horizontal plane differing by fifty yards in horizontal range; likewise, figures drawn to scale showing the vertical projections of the fifty per cent zones of salvos at various points in space. Tables giving corrections to be applied to gun and fuze are herein provided for the 1918 gun, and when used as described will place the centers of impact of the bursts in the above positions.

The difficulties encountered in determining the causes of apparent deviations and applying corrections to these deviations in antiaircraft fire leads the writer to believe that a solution for the above is a larger effective danger volume, which is obtained by giving each gun a different elevation and the projectiles in each salvo a different fuze setting. By enlarging the danger volume in this manner larger errors in quadrant elevation and fuze range can be made than with the method now in use, (*i. e.*, of using the same trajectory and fuze range for all guns) and still keep the target under effective fire.

The dispersion of the fuze is not large and will continue to get smaller with future models. The gun dispersion can be reduced to a small amount by correcting for the backlash and lost motion in the sighting mechanism and by calibration.

In service firing, especially in forward areas, it is doubtful if adjustment of fire will be possible, even though the target continue in *rectilinear flight after the first salvo, as the bursts from any one battery* can not be identified—another reason for a larger effective danger volume to make adjustment unnecessary. Where observation along the line of flight is possible, it can be used to advantage if rectilinear flight is maintained and the target remains in the field of fire long enough for the corrected shots to reach it, which is, of course, expecting too much of a target.

This method presupposes materiel in adjustment, the unit in a reasonably high state of efficiency, careful preparation of fire, and the use

of percentage devices to apply corrections to fuze and altitude during the firing.

Explanation of:

(1) Using the trajectory and fuze setter curves for the 3-inch A. A. Gun, *model of* 1918; *mounted on* Auto Trailer carriage, model 1917; A. A. Shrapnel, Mk. I; fuze Scovil Mk. III; the following is necessary:

(a) For every 0.5 unit fuze range curve intersection with all 100-mil trajectories measure off 75 yards horizontally to the right of the intersection, and number this point 1 and letter the intersection T, the former being the desired center of impact for bursts fired from gun No. 1, the latter being the position of the target (see Fig. 1).

(b) Measure the offset of point 1 to the above 100-mil trajectory.

(c) Prolong the offset above to intersect the next lower 100-mil trajectory and measure its length.

(d) Using the values obtained from (b) and (c), interpolate for the angle subtended by the offset in (b). This angle ($\Delta\ i$) is the change in elevation necessary to put the trajectory of gun No. 1 through point 1. As seen from Figure 1, points 2, 3, and 4 (the remaining centers of impact) are $+\ 25$, $-\ 25$, and $-\ 75$ yards respectively from T; however, the offsets from these points need not be measured as they are corresponding sides of similar triangles (assuming the trajectory between the limiting offsets to be a straight line). The changes in elevation necessary to put trajectories through points 2, 3 and 4 are therefore proportional to the change in elevation for point 1.

An example showing how the $\Delta\ i$'s for points 1, 2, 3, and 4 are determined for a position of the target at $B = x$, $i = 800$ mils, follows (see *Fig.* 5):

36 yards = offset from point 1 to 800-mil trajectory.

600 yards = distance between 700- and 800-mil trajectories as measured from above offset prolonged. $\Delta\ i$ for points 1 and 4 = $\frac{36}{600}(100) = 6$ mils. $\Delta\ i$ for points 2 and 3 $= \frac{6}{3} = 2$ mils.

As a change in elevation causes a change in horizontal range and altitude; it is necessary to correct the fuze burning in each of the four trajectories (1, 2, 3, and 4) so that the bursts will take place at points 1, 2, 3, and 4. An example illustrating the above for a position of the target at $B = 12$, $i = 800$ mils follows:

From the firing tables: 13.28 seconds = time of flight for $B = 12$, $i = 800$ mils. 24 yards = effect on horizontal range for a 6-mil change

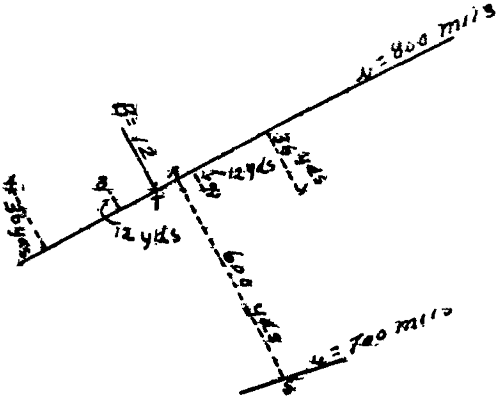

FIG. 1

Scale:)1 inch = 100 yards (Tr and rs are to a scale of 1 inch = 500 yards).

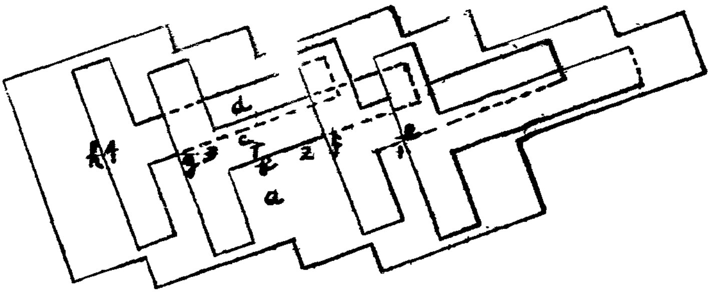

FIG. 2

Vertical Projection of the Danger Space, of the 50% Zone, of a salvo of H. E. shell, for the 3-inch A. A. Gun, Model 1918, mounted on Auto Trailer Carriage, Model 1917. Fuze, Scovil Mk. III; Projectile, 15 lbs.; M. V., 2400 f. s.

Point; B = 8, i = 500 mils, 7.80″= Time of flight

	Gun No. 1	Gun No. 2	Gun No. 3	Gun No. 4
$\triangle$ i	7	2	2	7
$\triangle$ h R	11	3	3	11
$\triangle$ H	26	7	7	26
Arbitrary Corrector Cor.	—2	—1	+1	+2

37 yds. = $\triangle$ R for .1 B
33 yds. = P. E. along trajectory
5 yds. = P. E. $\perp$ trajectory

Scale: 1 inch = 100 yards.

in elevation (increase in horizontal range for a decrease in elevation) 28 yards = effect on altitude for a 6-mil change in elevation (decrease in altitude for a decrease in elevation). 8 yards = effect on horizontal range for a 2-mil change in elevation. 9 yards = effect on altitude for a 2-mil change in elevation. Plot *a*, *b*, *c*, and *d* in trajectories 1, 2, 3, and 4, respectively, using T as the origin and the following coordinates: 24, 28; 8, 9; 8, 9; 24, 28 yards, respectively. The mean $\triangle$ R for 0.1B between B = 11.5 — 12.5 is 42 yards. Therefore point *e* is found to be 2 (42) = + 84 yards from *a* on trajectory No. 1. Point *f* is 1 (42) = + 42 yards from *b* on trajectory No. 2. Point *g* is 1 (42) = — 42 yards from *c* on trajectory No. 3. Point *h* is 2 (42) = — 84 yards from *d* on trajectory No. 4.

The changes in elevation ($\triangle$ *i*) for points 1, 2, 3, and 4 for all fuzes and trajectories can be applied by using the principles in the "Method of Eliminating Errors in the Elevating Mechanism of Antiaircraft Guns," in the September, 1925, number, COAST ARTILLERY JOURNAL, by adding algebraically the $\triangle$ *i*'s tabulated in Table I to the corrections for errors in the sighting mechanism, and if necessary calibration corrections (see Tables). The proper fuze burning for these points is obtained by using a Fuze Range Percentage Corrector and in addition setting the following arbitrary corrections on the corrector ring of the fuze setters:

i	No. 1 Gun	No. 2 Gun	No. 3 Gun	No. 4 Gun
178-1000 mils	—2	—1	—1	—2
1100-1200 mils	—1	0	0	—1
1300-1500 mils	0	0	0	0

Note: A minus correction increases the fuze range.

An example showing how the vertical projection of the danger volume for the 50% zone of a salvo, for a target at B = 12, *i* = 800 mils, is determined follows (see Fig. 5):

(*j*) Plot the vertical projection of the volume of the H. E. shell at points *e*, *f*, *g*, and *h*, each point being the C. I. of bursts for B = 12.2, *i* = 794; B = 12.1, *i* = 798; B = 11.9, *i* = 802; B = 11.8 *i* = 806 mils, respectively (see Fig. 5).

(*k*) 33 yards = P. E. along the trajectories.

(*l*) 9 yards = P. E. normal to the trajectories (in the plane of trajectory).

(*m*) Draw the vertical projection of the danger volume of the salvo using the values in (*k*) and (*l*) above.

Table I gives the change in elevation and corrector correction for

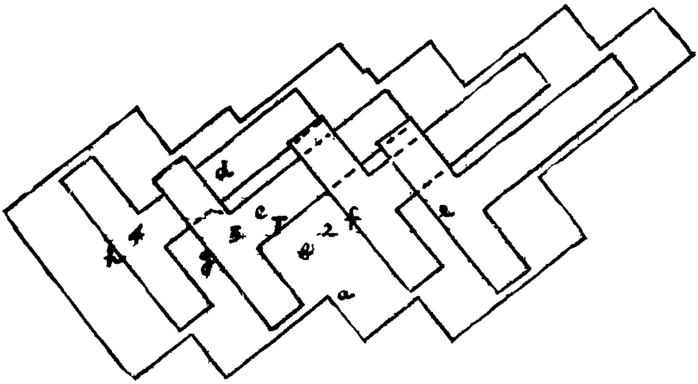

FIG. 3

Point; B = 8, i = 800 mils, 8.07″ = Time of flight

	Gun No. 1	Gun No. 2	Gun No. 3	Gun No. 4
△ i	11	4	4	11
△ h R	31	11	11	31
△ H	33	12	12	33
Arbitrary Corrector Cor.	—2	—1	+1	+2

42 yds. = △ R for .1 B
34 yds. = P. E. along trajectory
5 yds. = P. E. ⊥ trajectory

Scale: 1 inch = 100 yards.

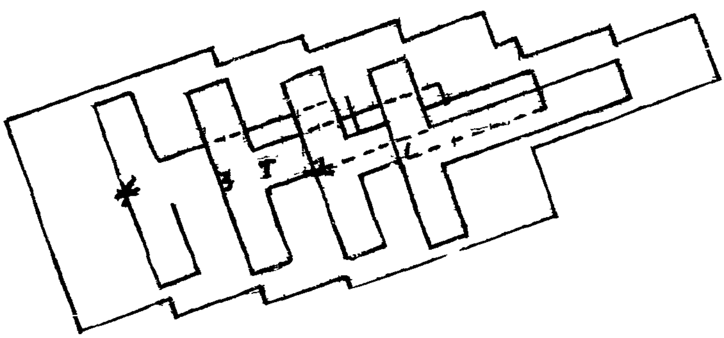

FIG. 4

Point; B = 12, i = 500 mils, 12.16″ = Time of flight

	Gun No. 1	Gun No. 2	Gun No. 3	Gun No. 4
△ i	3	1	1	3
△ h R	6	2	2	6
△ H	15	5	5	15
Arbitrary Corrector Cor.	—2	—1	+1	+2

33 yds. = △ R for .1 B
46 yds. = P. E. along trajectory
8 yds. = P. E. ⊥ trajectory

Scale: 1 inch = 100 yards.

each gun in the battery, for every fuze and 100-mil trajcetory, necessary to place the bursts of each salvo at the same altitude and at intervals of fifty yards in horizontal range. The changes are correct for trajectories $\pm$ 50 mils from the trajectory for which they are computed.

Table II is for explanatory purposes. Table III shows the form for use in firing.

As seen from the figures and tables, the differences in angular height from T for points *e* and *h* are the same; likewise, the differences for points *f* and *g* are the same. We have a difference of 150 yards in horizontal range between points *e* and *h*, and a difference of 0.4 unit of fuze. We have a danger volume of approximately 350 yards along the horizontal, and approximately 150 yards along the vertical. This *effective* danger volume is several times greater than the danger volume of a salvo fired with the same fuze and elevation. This obviously increases the probability of hitting.

The gun being pointed in direction, there are two things necessary in order to hit the target; namely, the correct trajectory, and the correct fuze burning along that trajectory. The fuze burning has been varied by using different fuze settings. The correct trajectory is obtained by using four different trajectories as described above. It is firmly believed that in a large majority of cases one, at least, of these trajectories will place destructive fire on the target. However, if the target is not included between the lowest and highest bursts of the salvo, arbitrary corrections in altitude can be used so as to include the target. Note that the difference in angular height between bursts *e* and the target and *h* and the target is the same. Likewise, the difference between bursts *f* and *g* and the target is the same. Therefore, if the target is between the lowest and highest bursts, the probability is that the target will be in the danger volume as described herein. The proper direction can be obtained during firing by using a series of numbered graduations as indices on the adjustable index of the lateral deflection scale. By changing the index any correction can be applied instantly. The graduations should be five mils on this scale.

RULES FOR ADJUSTMENT OF FIRE

(*a*) If the angular height of the target does not lie between that of the lowest and highest burst for any salvo, place an arbitrary correction in altitude (in multiples of 25 yards) on the R. A. Corrector.

(*b*) Make a minus correction when the angular height of the target is greater than that of the highest burst.

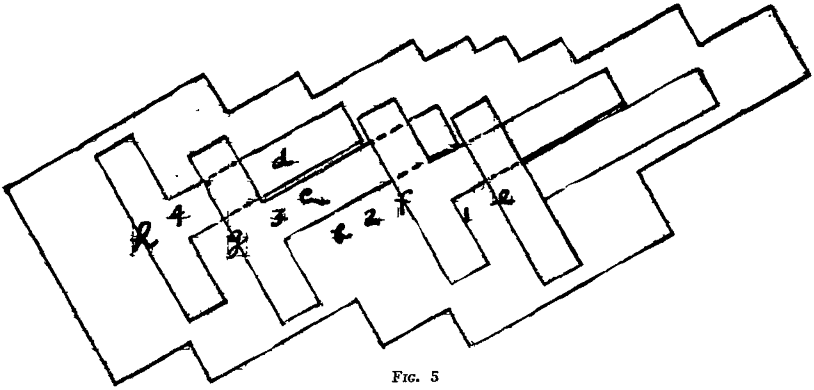

Fig. 5

Point; B = 12, i = 800 mils, 13.28″ = Time of flight

	Gun No. 1	Gun No. 2	Gun No. 3	Gun No. 4
△ i	6	2	2	6
△ h R	23	8	8	23
△ H	28	9	9	28
Arbitrary Corrector Cor.	—2	—1	+1	+2

42 yds. = △ R for .1 B
49 yds. = P. E. along trajectory
9 yds. = P. E. ⊥ trajectory

Scale: 1 inch = 100 yards.

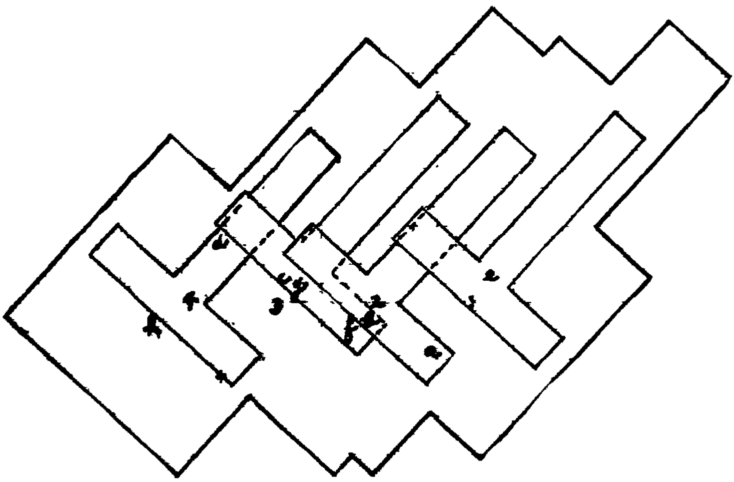

Fig. 6

Point; B = 12, i = 1100 mils, 14.63″ = Time of flight

	Gun No. 1	Gun No. 2	Gun No. 3	Gun No. 4
△ i	9	3	3	9
△ h R	53	18	18	53
△ H	27	9	9	27
Arbitrary Corrector Cor.	—1	0	0	+1

48 yds. = △ R for .1 B
54 yds. = P. E. along trajectoı
11 yds. = P. E. ⊥ trajectory

Scale: 1 inch = 100 yards.

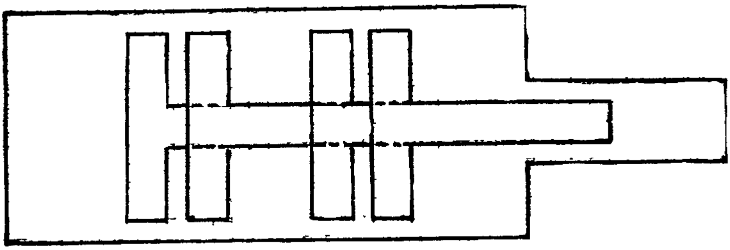

FIG. 7

Point; B = 16, i = 500 mils, 16.8″ = Time of flight

	Gun No. 1	Gun No. 2	Gun No. 3	Gun No. 4
△ i	1	0	0	1
△ h R	2	0	0	2
△ H	7	0	0	7
Arbitrary Corrector Cor.	—2	—1	+1	+2

32 yds. = △ R for .1 B
62 yds. = P. E. along trajectory
13 yds. = P. E. ⊥ trajectory

Scale: 1 inch = 100 yards.

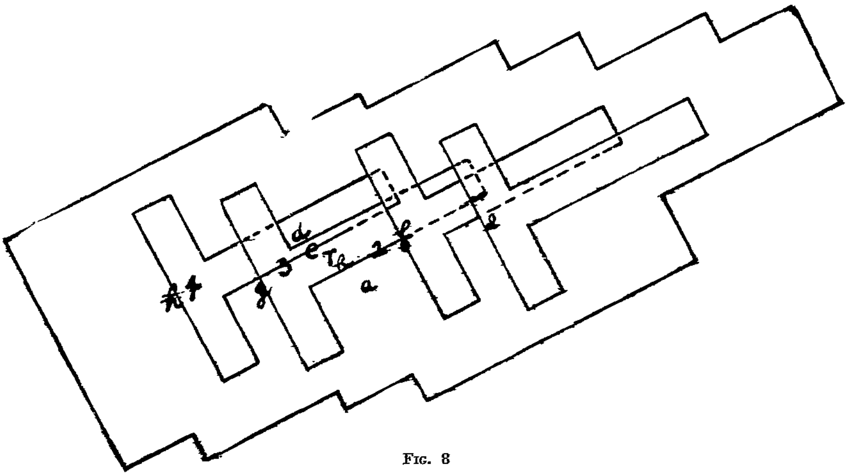

FIG. 8

Point; B = 16, i = 800 mils, 19.20″ = Time of flight

	Gun No. 1	Gun No. 2	Gun No. 3	Gun No. 4
△ i	3	1	1	3
△ h R	15	2	2	15
△ H	18	2	2	18
Arbitrary Corrector Cor.	—2	—1	+1	+2

35 yds. = △ R for .1 B
69 yds. = P. E. along trajectory
18 yds. = P. E. ⊥ trajectory

Scale: 1 inch = 100 yards.

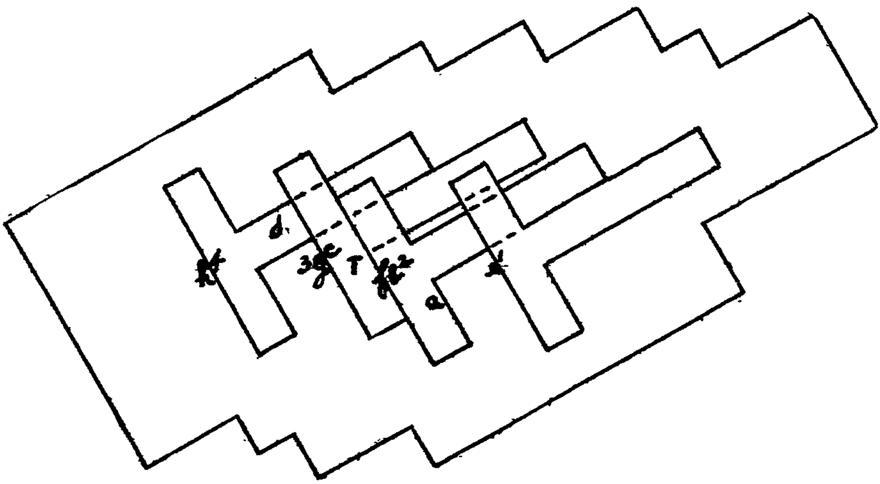

Fig. 9

Point; B = 16, i = 1100 mils, 23.36″ = Time of flight

	Gun No. 1	Gun No. 2	Gun No. 3	Gun No. 4
△ i	5	2	2	5
△ h R	42	17	17	42
△ H	23	9	9	23
Arbitrary Corrector Cor.	—1	0	0	+1

38 yds. = △ R for .1 B
81 yds. = P. E. along trajectory
22 yds. = P. E. ⊥ trajectory

Scale: 1 inch = 100 yards.

TABLE I

Elevation corrections for placing the bursts of a salvo at the same altitude and differing by 50 yards in horizontal range. For the 3-inch A. A. Gun, Model of 1918, mounted on Auto Trailer Carriage, Model of 1917; A. A. Shrapnel, Mark I; Fuze, Scovil, Mk. III; Wt. 15 lbs.; M. V. 2400 F/S.

B	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4
2.0	300	—15	— 5	+ 5	+15	400	—19	— 6	+ 6	+19
2.5		13	4	4	13		16	5	5	16
3.0		8	3	3	8		12	4	4	12
3.5		8	3	3	8		10	3	3	10
4.0		8	3	3	8		9	3	3	9
4.5		6	2	2	6		7	2	2	7
5.0		6	2	2	6		7	2	2	7
5.5		6	2	2	6		7	2	2	7
6.0		5	2	2	5		6	2	2	6
6.5		4	1	1	4		5	2	2	5
7.0		3	1	1	3		5	2	2	5
7.5		2	1	1	2		4	1	1	4
8.0		2	1	1	2		3	1	1	3
8.5		2	1	1	2		3	1	1	3
9.0		2	1	1	2		3	1	1	3
9.5		2	1	1	2		3	1	1	3
10.0		1	0	0	1		2	1	1	2
10.5		1	0	0	0		2	1	1	2
11.0		0	0	0	0		2	1	1	2
11.5		0	0	0	0		2	1	1	2
12.0		S 0	0	0	0		2	1	1	2
12.5		0	0	0	0		2	1	1	2
13.0		0	0	0	0		1	0	0	1
13.5		+ 2	+ 1	— 1	— 2		1	0	0	1
14.0		2	1	1	2		0	0	0	0
14.5		2	1	1	2		S 0	0	0	0
15.0		2	1	1	2		0	0	0	0
15.5		2	1	1	2		+ 1	0	0	— 1
16.0		2	1	1	2		1	0	0	1
16.5		2	1	1	2		1	0	0	1
17.0		2	1	1	2		1	0	0	1
17.5		2	1	1	2		2	+ 1	— 1	2
18.0		2	1	1	2		2	1	1	2
18.5		3	1	1	3		2	1	1	2
19.0		3	1	1	3		2	1	1	2
19.5		3	1	1	3		2	1	1	2
20.0		3	1	1	3		3	1	1	3
20.5		3	1	1	3		3	1	1	3
21.0		3	1	1	3		3	1	1	3

S = Summit of trajectory.
Signs of Δi, for all fuzes up to S, are minus for No. 1, No. 2; plus for No. 3, No.4.
Arbitrrary corrector corrections for above elevations are: No. 1 = —2, No. 2 = —1, No. 3 = + 1, No. 4 = + 2.

TABLE I (*Continued*)

B	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4
2.0	500	−24	−8	+8	+24	600	−33	−11	+11	+33
2.5		20	7	7	20		28	9	9	28
3.0		18	6	6	18		24	8	8	24
3.5		16	5	5	16		23	8	8	23
4.0		14	5	5	14		20	7	7	20
4.5		13	4	4	13		18	6	6	18
5.0		12	4	4	12		15	5	5	15
5.5		11	4	4	11		13	4	4	13
6.0		10	3	3	10		12	4	4	12
6.5		9	3	3	9		11	4	4	11
7.0		8	3	3	8		11	4	4	11
7.5		8	3	3	8		9	3	3	9
8.0		7	2	2	7		9	3	3	9
8.5		6	2	2	6		8	3	3	8
9.0		6	2	2	6		8	3	3	8
9.5		5	2	2	5		7	2	2	7
10.0		5	2	2	5		6	2	2	6
10.5		4	1	1	4		6	2	2	6
11.0		4	1	1	4		6	2	2	6
11.5		4	1	1	4		5	2	2	5
12.0		3	1	1	3		4	1	1	4
12.5		3	1	1	3		4	1	1	4
13.0		2	1	1	2		4	1	1	4
13.5		2	1	1	2		3	1	1	3
14.0		2	1	1	2		3	1	1	3
14.5		2	1	1	2		2	1	1	2
15.0		2	1	1	2		2	1	1	2
15.5		1	0	0	1		2	1	1	2
16.0		1	0	0	1		2	1	1	2
16.5		S 0	0	0	0		1	0	0	1
17.0		+1	0	0	−1		1	0	0	1
17.5		1	0	0	1		0	0	0	0
18.0		1	0	0	1		S 0	0	0	0
18.5		1	0	0	1		0	0	0	0
19.0		1	0	0	1		+1	0	0	+1
19.5		1	0	0	1		1	0	0	1
20.0		1	0	0	1		1	0	0	1
20.5		2	+1	−1	2		1	0	0	1
21.0		2	1	1	2		2	+1	−1	2

Arbitrary corrector corrections same as for $i = 400$.

TABLE I (*Continued*)

B	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4
2.0	700	—33	—11	+11	+33	800	—36	—12	+12	+36
2.5		30	10	10	30		30	10	10	30
3.0		25	8	8	25		26	9	9	26
3.5		22	7	7	22		23	8	8	23
4.0		20	7	7	20		22	7	7	22
4.5		18	6	6	18		19	6	6	19
5.0		16	5	5	16		18	6	6	18
5.5		15	5	5	15		16	5	5	16
6.0		14	5	5	14		14	5	5	14
6.5		13	4	4	13		13	4	4	13
7.0		11	4	4	11		12	4	4	12
7.5		11	4	4	11		12	4	4	12
8.0		10	3	3	10		11	4	4	11
8.5		9	3	3	9		10	3	3	10
9.0		9	3	3	9		10	3	3	10
9.5		8	3	3	8		9	3	3	9
10.0		8	3	3	8		9	3	3	9
10.5		7	2	2	7		9	3	3	9
11.0		6	2	2	6		8	3	3	8
11.5		6	2	2	6		7	2	2	7
12.0		5	2	2	5		6	2	2	6
12.5		4	1	1	4		6	2	2	6
13.0		4	1	1	4		6	2	2	6
13.5		4	1	1	4		5	2	2	5
14.0		3	1	1	3		5	2	2	5
14.5		3	1	1	3		5	2	2	5
15.0		3	1	1	3		4	1	1	4
15.5		3	1	1	3		3	1	1	3
16.0		2	1	1	2		3	1	1	3
16.5		2	1	1	2		3	1	1	3
17.0		2	1	1	2		2	1	1	2
17.5		2	1	1	2		2	1	1	2
18.0		1	0	0	1		2	1	1	2
18.5		1	0	0	1		1	0	0	1
19.0		S 0	0	0	0		1	0	0	1
19.5		0	0	0	0		0	0	0	0
20.0		+ 1	0	0	— 1		S 0	0	0	0
20.5		1	0	0	1		0	0	0	0
21.0		1	0	0	1		+ 1	0	0	— 1

Arbitrary corrector corrections same as for $i = 400$ mils.

TABLE I (*Continued*)

B	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4
2.0	900	—42	—14	+14	+42	1000	—44	—15	+15	+44
2.5		35	11	11	35		37	12	12	37
3.0		34	11	11	34		34	11	11	34
3.5		30	10	10	30		31	10	10	31
4.0		26	9	9	26		28	9	9	28
4.5		23	8	8	23		25	8	8	25
5.0		21	7	7	21		22	7	7	22
5.5		19	6	6	19		21	7	7	21
6.0		17	6	6	17		18	6	6	18
6.5		15	5	5	15		17	6	6	17
7.0		14	5	5	14		16	5	5	16
7.5		13	4	4	13		14	5	5	14
8.0		12	4	4	12		14	5	5	14
8.5		12	4	4	12		13	4	4	13
9.0		11	4	4	11		12	4	4	12
9.5		10	3	3	10		11	4	4	11
10.0		10	3	3	10		11	4	4	11
10.5		9	3	3	9		10	3	3	10
11.0		9	3	3	9		10	3	3	10
11.5		8	3	3	8		9	3	3	9
12.0		8	3	3	8		9	3	3	9
12.5		7	2	2	7		8	3	3	8
13.0		7	2	2	7		8	3	3	8
13.5		6	2	2	6		7	2	2	7
14.0		6	2	2	6		6	2	2	6
14.5		5	2	2	5		6	2	2	6
15.0		5	2	2	5		6	2	2	6
15.5		5	2	2	5		6	2	2	6
16.0		4	1	1	4		5	2	2	5
16.5		4	1	1	4		4	1	1	4
17.0		3	1	1	3		4	1	1	4
17.5		2	1	1	2		3	1	1	3
18.0		2	1	1	2		2	1	1	2
18.5		1	0	0	1		2	1	1	2
19.0		1	0	0	1		2	1	1	2
19.5		1	0	0	1		1	0	0	1
20.0		0	0	0	0		0	0	0	0
20.5		S 0	0	0	0		S 0	0	0	0
21.0		0	0	0	0		0	0	0	0

Arbitrary corrector corrections same as for $i = 400$ mils.

TABLE I (*Continued*)

B	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4
2.0	1100	−47	−16	+16	+47	1200	−54	−18	+18	+54
2.5		38	13	13	38		45	15	15	45
3.0		36	12	12	36		40	13	13	40
3.5		31	10	10	31		35	12	12	35
4.0		25	8	8	25		31	10	10	31
4.5		23	8	8	23		26	9	9	26
5.0		21	7	7	21		24	8	8	24
5.5		19	6	6	19		22	7	7	22
6.0		18	6	6	18		20	7	7	20
6.5		17	6	6	17		19	6	6	19
7.0		16	5	5	16		18	6	6	18
7.5		15	5	5	15		17	6	6	17
8.0		14	5	5	14		15	5	5	15
8.5		13	4	4	13		14	5	5	14
9.0		13	4	4	13		13	4	4	13
9.5		12	4	4	12		13	4	4	13
10.0		11	4	4	11		12	4	4	12
10.5		11	4	4	11		11	4	4	11
11.0		10	3	3	10		11	4	4	11
11.5		9	3	3	9		10	3	3	10
12.0		9	3	3	9		9	3	3	9
12.5		8	3	3	8		9	3	3	9
13.0		8	3	3	8		8	3	3	8
13.5		7	2	2	7		8	3	3	8
14.0		7	2	2	7		7	2	2	7
14.5		7	2	2	7		7	2	2	7
15.0		6	2	2	6		6	2	2	6
15.5		6	2	2	6		6	2	2	6
16.0		5	2	2	5		5	2	2	5
16.5		4	1	1	4		4	1	1	4
17.0		4	1	1	4		4	1	1	4
17.5		3	1	1	3		4	1	1	4
18.0		3	1	1	3		3	1	1	3
18.5		2	1	1	2		3	1	1	3
19.0		1	0	0	1		2	1	1	2
19.5		0	0	0	0		0	0	0	0
20.0		S 0	0	0	0		S 0	0	0	0
20.5		+ 2	+ 1	− 1	− 2		+ 2	+ 1	− 1	− 2
21.0		2	1	1	2		2	1	1	2

Arbitrary corrector corrections for above elevations are: No. 1 = −1, No. 2 = 0, No. 3 = 0, No. 4 = +1.

TABLE I (*Continued*)

B	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4
2.0	1300	—57	—19	+19	+57	1400	—56	—19	+19	+56
2.5		47	16	16	47		45	15	15	45
3.0		44	15	15	44		42	14	14	42
3.5		38	13	13	38		34	11	11	34
4.0		33	11	11	33		30	10	10	30
4.5		30	10	10	30		27	9	9	27
5.0		27	9	9	27		25	8	8	25
5.5		25	8	8	25		23	8	8	23
6.0		23	8	8	23		21	7	7	21
6.5		21	7	7	21		20	7	7	20
7.0		19	6	6	19		18	6	6	18
7.5		18	6	6	18		17	6	6	17
8.0		17	6	6	17		16	5	5	16
8.5		16	5	5	16		15	5	5	15
9.0		15	5	5	15		14	5	5	14
9.5		14	5	5	14		13	4	4	13
10.0		13	4	4	13		13	4	4	13
10.5		12	4	4	12		12	4	4	12
11.0		12	4	4	12		11	4	4	11
11.5		10	3	3	10		11	4	4	11
12.0		10	3	3	10		10	3	3	10
12.5		9	3	3	9		10	3	3	10
13.0		9	3	3	9		9	3	3	9
13.5		9	3	3	9		9	3	3	9
14.0		8	3	3	8		8	3	3	8
14.5		7	2	2	7		8	3	3	8
15.0		7	2	2	7		7	2	2	7
15.5		6	2	2	6		7	2	2	7
16.0		6	2	2	6		7	2	2	7
16.5		6	2	2	6		7	2	2	7
17.0		5	2	2	5		6	2	2	6
17.5		5	2	2	5		5	2	2	5
18.0		4	1	1	4		5	2	2	5
18.5		4	1	1	4		3	1	1	3
19.0		2	1	1	2		2	1	1	2
19.5		1	0	0	1		2	1	1	2
20.0		S 0	0	0	0		S 0	0	0	0
20.5		0	0	0	0		0	0	0	0
21.0		0	0	0	0		0	0	0	0

Arbitrary corrector corrections for above elevations are: No. 1 = 0, No. 2 = 0, No. 3 = 0, No. 4 = 0.

TABLE I (*Continued*)

B	i	Δi, No. 1	Δi, No. 2	Δi, No. 3	Δi, No. 4
2.0	1500	—58	—19	+19	+58
2.5		48	16	16	48
3.0		42	14	14	42
3.5		37	12	12	37
4.0		33	12	12	33
4.5		29	10	10	29
5.0		27	9	9	27
5.5		25	8	8	25
6.0		23	8	8	23
6.5		21	7	7	21
7.0		20	7	7	20
7.5		19	6	6	19
8.0		17	6	6	17
8.5		17	6	6	17
9.0		15	5	5	15
9.5		14	5	5	14
10.0		14	5	5	14
10.5		13	4	4	13
11.0		12	4	4	12
11.5		11	4	4	11
12.0		11	4	4	11
12.5		10	3	3	10
13.0		9	3	3	9
13.5		9	3	3	9
14.0		8	3	3	8
14.5		8	3	3	8
15.0		8	3	3	8
15.5		8	3	3	8
16.0		7	2	2	7
16.5		7	2	2	7
17.0		7	2	2	7
17.5		6	2	2	6
18.0		6	2	2	6
18.5		5	2	2	5
19.0		4	1	1	4
19.5		3	1	1	3
20.0		2	1	1	2
20.5		S 0	0	0	0
21.0		0	0	0	0

Arbitrary corrector corrections same as for $i = 1300$.

TABLE II

Explanatory table showing the changes in elevation necessary for Gun No. 1 to correct for the errors in the sighting mechanism as well as placing the bursts at the same altitude as the other bursts of the salvo.

Gun	*i*	B	Δi	Average A.C.I.B.	Total Δi, I.B.	Average A.C.D.B.	Total Δi, D.B.
No. 1	800	2.0	—36	+24	—12	+66	+30
		2.5	30	25	— 5	66	36
		3.0	26	28	+ 2	64	38
		3.5	23	26	+ 3	63	40
		4.0	22	23	+ 1	65	43
		4.5	19	27	+ 8	62	43
		5.0	18	27	+ 9	62	44
		5.5	16	29	+13	57	41
		6.0	14	31	+17	55	41
		6.5	13	33	+20	55	42
		7.0	12	30	+18	53	41
		7.5	12	32	20	51	39
		8.0	11	32	21	49	38
		8.5	10	35	25	46	36
		9.0	10	36	26	47	37
		9.5	9	37	28	45	36
		10.0	9	39	30	42	33
		10.5	9	43	34	40	31
		11.0	8	45	37	37	29
		11.5	7	41	34	41	34
		12.0	6	42	36	43	37
		12.5	6	44	38	40	34
		13.0	6	45	39	38	32
		13.5	5	46	41	37	32
		14.0	5	43	38	35	30
		14.5	5	46	41	35	30
		15.0	4	46	42	31	27
		15.5	3	49	46	28	25
		16.0	3	47	44	27	24
		16.5	3	50	47	27	24
		17.0	2	50	48	25	23
		17.5	2	52	50	24	22
		18.0	2	54	52	27	25
		18.5	1	55	54	27	26
		19.0	1	56	55	27	26
		19.5	0	57	57	24	24
		20.0	S 0	53	53	23	23
		20.5	0	55	55	24	24
		21.0	+ 1	54	55	24	25

NOTE—Column 4 is obtained from Table I; columns 5 and 7 are arbitrary corrections for errors in the sighting and elevating mechanism (see COAST ARTILLERY JOURNAL, Vol. 63, p. 275); column 6 = columns 4 + 5; column 8 = columns 4 + 7. If there are no errors in the sighting and elevating mechanism, column 4 will give the changes in elevation (*i. e.*, use Δ *i*'s in Table I).

TABLE III

Values obtained from Table II

Δi, I. B.	B	Δi, D. B.
—12	2.0	+30
— 5	2.5	36
+ 2	3.0	38
3	3.5	40
1	4.0	43
8	4.5	43
9	5.0	44
13	5.5	41
17	6.0	41
20	6.5	42
18	7.0	41
20	7.5	39
21	8.0	38
25	8.5	36
26	9.0	37
28	9.5	36
30	10.0	33
34	10.5	31
37	11.0	29
34	11.5	34
36	12.0	37
38	12.5	34
39	13.0	32
41	13.5	32
38	14.0	30
41	14.5	30
42	15.0	27
46	15.5	25
44	16.0	24
47	16.5	24
48	17.0	23
50	17.5	22
52	18.0	25
54	18.5	26
55	19.0	26
57	19.5	24
53	20.0	23
55	20.5	24
54	21.0	25

Method of using table.—Given: the gun is firing at elevations 750 — 850 mils, and the fuzes are decreasing.

Required: the Δi necessary to place the bursts for fuzes 12.3 to 12.7, inclusive, at the altitude of the target and at an interval of 50 yards from the burst of gun No. 2.

Solution: Enter column 3 and read + 34 opposite B = 12.5.

Note—If fuzes are increasing enter column 1. An arbitrary corrector correction of — 2 is set on the corrector ring of the fuze setter for elevations 300 — 1000 mils. + 34 mils is applied to the elevation of gun No. 1 by means of the arbitrary correction knob.

Notes on Artillery Fire

By General Dedieu-Anglade
Commanding the Artillery of the 16th French Army Corps

Translated from *Revue d'Artillerie,* in the Military Intelligence Division, General Staff

Editor's Note.—The reader will see that the ideas of the author are at variance with the doctrine of our own Service Schools. *That his ideas are also at variance with prevailing French doctrine is indicated by this editorial* footnote appearing in the original: "The editors call attention to the fact that the insertion of an article in the *Revue d'Artillerie* does not confer on it any official character. The author takes entire responsibility for his opinions and choice of arguments used to support them."

I. Effects of Mass

IN a remarkable work which appeared before the war,* Colonel (afterwards General) Rouquerol showed that French artillerists were making a great mistake in 1870 in not putting into practice the effects of mass. He earnestly requested organization of the artillery command with a view to realizing these effects in the future.

Was he understood?

It is sufficient to go to the vicinity of Metz, to visit the region of Morhange and Etangs, to live over again the battle of August 18-19-20, 1914, engaged in forty-four years later by the 2d French Army, to answer "no."

Afterwards, in the course of four years' struggle, we see on the same sector great quantities of guns of all calibers being fired at one time, some causing destruction in order to open the way for the infantry; some destroying or neutralizing batteries; others interdicting, harassing, infecting, "raking," etc.

Much noise, much ammunition, but little or no mass effect, because all these guns were dispersing their trajectories in space and also "in time."

The effects of mass, that is to say, the sudden and adjusted concentration of a mass of trajectories on well determined objectives, were attained by a few groups. They were always a great success, but were due to individual initiative.

Indispensable conditions for realizing these effects are:

(a) Proper organization of the artillery command.
(b) Materiel suitable for firing maneuvers.
(c) Appropriate methods for fire and fire direction.

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* *"L'Artillerie à la bataille du 18 aout 1870"* (Artillery in the battle of August 18, 1870), Paris, Berger-Levrault, 1906.

(a) *Organization of the command.*—As we are anxious to write nothing but what we have experienced, we shall not go above the army corps.

Did the army corps direct artillery fire? Was it organized to direct it?

Before the war the rôle of commanding officer of artillery of the army corps was daily tending to .disappear. The latest conceptions presented it as the rôle of technical adviser and above all that of ammunition server. A field regiment in four groups was indeed left under his direct orders, but beginning with the first battles we saw this regiment cut in half and distributed among the infantry divisions. Very often the colonel and lieutenant colonel were left in the air, and it seems that even the general artillery officer was not always consulted about this division. Decentralization for the benefit of the infantry divisions was then complete. It goes without saying that this period did not record any mass effects; it could not produce them.

This evil prevailed during the rest of the year 1914 and during all the campaign of 1915. The heavy artillery which was already of importance, although made up of all kinds of guns, could have produced mass effects, but placed under the exclusive orders of the army it played a rôle apart. It was too far away, especially on the 9th of May in Artois and the 25th of September in Champagne. We have to wait until 1917 to record a reorganization of the artillery command. The infantry divisions then saw their divisional artillery staffs broadly organized and their materiel considerably reinforced by heavy modern guns. On the other hand, the commanding officer of the heavy artillery of the army corps, who had appeared in 1916, remained the poor commanding officer of a regiment equipped with Bange materiel more than anything else. Rising artillery officers took care not to see this command, because it was of secondary importance.

As to the commanding officer of the corps artillery, still technical adviser and furnisher of supplies, we were quite willing to recognize, on paper, his mission of coordinating the employment of all the artillery. As a matter of fact, under pretext of counter battery, he was confined to the rôle of first colonel of the regiment of the army corps. In brief, he was given his peacetime regiment equipped with larger but usually rather antiquated guns. In fact, it was 1918 before we saw all the heavy artillery of the army corps equipped with a group of 105's, several still retaining their 155 L. 77. Reorganization was made especially for the benefit of the infantry divisions; decentralization, not to say abdication, of the army corps was only the more accentuated.

Result: Up to the time of the armistice, battles were carried on

chiefly by divisions ("divisionals"). Mass effects were no more possible than they were in 1914.

Organization brought to light other difficulties. We shall limit ourselves to mentioning those which appear in connection with the following facts:

In March, 1918, four infantry divisions of one of our most celebrated army corps were holding the front of Mort-Homme at the fort of Vaux. Each infantry division had a group of 155 C. S. (Schneider howitzers), that it, 48 heavy modern guns in all. From the 11th to the 21st of March, the enemy beset one of the infantry divisions. The latter had no help other than the support of the guns of the corps heavy artillery, while the heavy modern guns of the neighboring infantry divisions remained silent. Because of the extent of the front, it would have been necessary to take the guns back temporarily for installation in the sector attacked. Unable to insist on this, the corps turned to the army and requested help which it should have been able to do without.

Many time, in May, June, September, and October, 1918, we saw the command of the corps prescribe general five-minute concentrations, either on nests of batteries or on works directly opposed to the infantry; but only too often were we able to state that important portions of the divisional artillery had had excellent reasons for refraining: reliefs, garrison fatigue, etc.

In the course of the pursuit of 1918, when the enemy was opposing us with nothing but machine guns, we saw the corps stop the heavy guns of its group; but the divisional artillery did not follow the same marching tactics. This was due to the bottling which very unfortunately retarded the march of the infantry.

In short, we saw the corps give up its organic artillery; we did not see the infantry divisions give up theirs.

These are the facts; all the dissertations on the characters of individuals will change nothing. Let war break out tomorrow, the same miscalculations will be made. Just as in 1870 and in 1914, the lack of peacetime organization will weigh heavily on the putting in operation of the artillery.

(b) *Materiel.*—Concentrations cannot be had with materiel without output (*debit*), without endurance, without efficacious range, without large fields of fire.

Because of not having believed in the tactics of the great defilade and because of having admitted that the same instrument was suitable for everything, the artillerists of 1914 felt great surprise when they saw their 75 was too short. Even when pushed up on the line of the riflemen, this gun was incapable of mass effects at the front of a corps.

It was the more incapable of this, when from the time of the first battle it was necessary, whether or no, to set it up back of covering masses and masks, the depth of which often absorbed more of its effectiveness than that considered normal by its constructors (maximum of efficiency at 2500 meters).

The Bange materiel which was our principal heavy artillery up to 1917 possessed endurance, but it had neither the output (*debit*) nor the manageability in battery indispensable for firing maneuvers.

The long-range artillery used at the end of the campaign was neither sufficiently numerous nor sufficiently enduring.

(c) *Methods of fire and fire direction.*—The prewar doctrine, "Neither instruments nor formulas," could not be the doctrine of effects of mass and surprise.

These effects did not become possible until the day when the artillerists could, thanks to instruments and formulas, do away with adjustment. This is perhaps the most considerable progress due to the war. Added to the long ranges which it renders practicable, it is expected to revolutionize all the tactics of yesterday.

II. Long Ranges

The control of the seas was an important trump-card. We will not say it was sufficient, because if we had not gained the victory on the Marne it would not have entered into play.

The indispensable control will henceforth be that of the air.

In this new kind of combat our groups of squadrons will require the support of land guns. These must act by effects of mass, by instantaneous and well-delivered concentration.

Will victory in the air render the decision? Possibly it will. Nevertheless, for many years to come, it will be necessary to envisage battles on land. The artillery will play a more important rôle in them than in the past. "More range," was the cry of the survivors of 1870. With the survivors of 1918 we cry, "More and more range."

Moreover, in destroying the present guns of the enemy we make it necessary to change our own so as to lengthen them. The enemy clearly showed us that they knew the importance of range. They will try to have it longer still; it will be necessary to go further than they.

The Berthas taught us that the paradox of yesterday was the truth of today. Long range no longer implies a heaviness incompatible with the needs of war. Did the Germans have guns easier to supply with ammunition, more suitable for accompanying the infantry, more movable in fact that the Berthas? Supplied up to their platforms by standard gauge railway, they could, without change of position, effect attacks

as far as Paris. Without going to extremes we must admit that the ordinary range of the future will be at least 15 to 20 kilometers. With like materiel what will become of our organizations of infantry divisions and army corps? Are we going to continue to burden our infantry divisions with from 8 to 10 kilometers of artillery wagons, retaining only a small number for the corps group?

Prudence demands that we do away with such folly.

In the distressing times of 1918, which guns contributed most toward restoring ("reestablishing") positions? Was not the new frame-work made up of long guns grouped anew in all haste?

How much easier and quicker this restoration would have been accomplished had the corps groups been more efficiently organized, equipped not only with long guns, but with their own aviation units. It is not possible for us to doubt that these are the guns which tomorrow will open fire, will form the fire shield demanded by some before the war, and which will permit the infantry divisions to appear on the scene. These divisions, light before all else, organically equipped with accompanying artillery, can and must insure success.

Certainly there will be glory for all, but each will play his own part: the commanding officer of the army corps as leader of the band, the commanding officers of the infantry divisions as principal musicians.

III. Firing Tactics

Whether it is a question of battle in the air or on land, the dominating idea is to seek the effect of mass in the minimum of time.

Attack.—The obstacles in the way of our infantry are:

Enemy artillery;
Machine guns.

With an artillery really qualified for effects of mass, it is to our interest, with all the artillery of the army corps (heavy artillery and divisional artillery), to fire successively:

1st. On the enemy artillery.
2d. For the immediate benefit of the infantry.

To strike both objectives at the same time is to practice dispersion.

Defense.—It is necessary to do everything possible to keep the enemy infantry from making progress. All the guns of the corps must block this infantry, neglecting other objectives if necessary. If the information is exact enough to permit our turning temporarily from the infantry to attack the artillery, for example, it will be to our interest to use in this change of objective the mass of all the guns.

Here again, chasing two rabbits at once must be forbidden.

IV. The Counterbattery

Very few believe in its efficaciousness.

We have already mentioned the evils connected with the organization of the group charged with this task (command of secondary importance; out of date materiel for a task which requires the most modern implements).

Answer will be made perhaps that the counterbattery was entrusted to the commanding officer of the corps artillery and that our criticism on the lack of organization of the command fails.

As a matter of fact, we have seen commanding officers of corps artillery, scrupulous observers of texts, keeping the headquarters ("command") of heavy artillery near the commanding post, sometimes 20 kilometers from the front. It goes without saying that under these conditions counterbattery was slow or inopportune, and usually ineffective. The commanding officer of the corps artillery cannot be the head of a group, an executive in the strict sense of the word. He is an engineer in command of constructors: commanding officers of the heavy artillery and commanding officers of the divisional artillery.

Like every good constructor, the commanding officer of the heavy artillery of the army corps must be in the workshop, that is, be a match for, if not ahead of, the commanding officers of the divisional artillery. We must no longer see him staying in counterbattery.

When it is a question of massing against the enemy artillery, he takes charge of the execution of the work by distributing to the divisional artillery their share in it. In his turn he receives from the latter the plan for the work for the immediate advantage of the infantry.

The struggle of the artillery is a more ticklish matter than the destruction of a trench.

Before the war we were already considering it as contingent. In order not to admit their powerlessness, the authors of the regulations of September 8, 1910, declared that the enemy batteries would not be more than 200 meters from the crest and solved the problem by zone fire.

Up to 1916 this was the only fire used. Then came the discussion of accurate fire (demolition fire). They destroyed batteries; a slow battle of factories before all else, because the demolished guns were soon replaced.

Neutralization fire followed demolition (accuracy) fire. With a section of Bange 120, for example, they pretended to neutralize one or more modern enemy batteries, such as the batteries of "21" howitzers. After that, it can be understood why some people are still skeptical as to the results of the artillery struggle.

The truth is that we did not pay the price. We should have given better equipment to the corps group. We should not have hesitated to reinforce it with all the artillery of the infantry divisions; in other words, to act by means of mass effects.

We could demonstrate by live facts that the application of these principles has always led to success. We shall add that the artillery struggle could not come to an end by itself. We should not undertake it except with a view to an immediate putting to account (exploitation) by the infantry. Counterbattery is not complete until after the taking of enemy guns. We have too often lost sight of this when fixing the objectives of attacks.

V. Liaison

What becomes of liaison under the doctrine of mass effects?

As early as the month of March, 1908, we were called to Clermont by General Percin to join an infantry company with an artillery battery. We recall the controversies of that period. After six years of effort with the drill ground and fall maneuvers, we did not cease, during the whole war, to seek a solution of the problem, either as commanding officer of regiments of 75, or as commanding officer of heavy artillery 20.

We finally declared that liaison through the lower ranks is incapable of winning the war. The foot soldier hit by machine-gun bullets would have liked to see his artillery annihilate the enemy machine gunner at once, but he was always incapable of locating him. Liaison has broken down and will break down again, less through material means than through the impossibility of discovery and observation.

On the contrary, under pretext of liason, we see deplorable breaking up and displacement of artillery units.

After the war, in the war games, we do not hesitate to take a group from the artillery colonel to give it to an infantry colonel, or even to a major.

Some people, leaving group commanders out of the question, demand temporary formation of odd groups comprising field guns, howitzers, and long guns. They also wish to combat not only machine guns but the enemy artillery.

Certainly liaison through the lower ranks is indispensable. It is necessary for artillerists and foot soldiers to know all about each other, but it is also necessary to do away with errors and to practice effects of mass. In support of our argument, we shall cite one fact out of a thousand.

Toward the end of October, 1918, a division stopped on the Serre in front of a certain bridge. A few members of the division had crossed the river all around the bridge, but they could not raise their heads without being mowed down by machine guns.

The enemy artillery scarcely remaining in existence at this time, the foot soldiers were in perfect liaison with their accompanying group. Nevertheless the commanding officer of the corps and the infantry division general, in person, looked on an entire day at vain attempts to cross because it was impossible to locate the machine guns.

All tired out, they decided during the night to concentrate all the artillery of the infantry division on the bridge. The crossing was made without loss. The machine-gun emplacements had been overthrown and the gunners killed.

Conclusion

The doctrine of the effects of mass was Napoleon's. Lost sight of by the French artillerists in 1870, it was insufficiently used during the last war.

The inevitable adoption of materiel with very long range, and with great output, and of firing methods doing away with preliminary adjustment, will be insisted upon still more vigorously.

Whether battle takes place in air or on land, the artillery will take part in it by means of sudden concentration of masses of trajectories.

As in previous wars the roaring of the guns will be uninterrupted; but the objectives will be hit successively in the order most advantageous to infantry action.

Whether it is a matter of attack or defense, we must avoid the dispersion of trajectories on striking several objectives simultaneously. But to write the doctrine into the regulations will be useless as long as the statutes of the artillery and the organization of the command will, in other respects, inevitably lead to dispersion.

The corps have always easily given the infantry divisions their organic regiment. They have not been able to recover even a part of the artillery of the infantry divisions, preferring to apply to the armies at the risk of leaving the divisional artillery batteries silent.

Decentralization, *a priori*, for the benefit of the infantry divisions, yesterday's mistake, would be more disastrous still with the long ranges of tomorrow. Besides, infantry divisions equipped with from 8 to 10 kilometers of wagons are no longer manageable. Engaged without effective protection from fire they would be but so much spoil for the enemy.

The fire shield, indispensable when they are moving, should be requested of the corps, assigning to it organically the greater part of the artillery.

It is the corps which is to conduct the artillery battle, the commanding officer of the heavy artillery and the commanding officers of the divisional artillery being the "contractors."

In order to be capable of immediate protection of the enormous artillery materiel of the corps and of immediate execution of its effects, the infantry division should be light above all else, and consequently should be comprised above all of infantry. It will be enough if their divisional artillery is organically equipped with accompanying units and a staff capable of playing the rôle of "sub-contractor" of the corps groups, that is, of temporarily absorbing the heavy artillery reinforcements.

The doctrine which seeks mass effect does not exclude liaison of the arms. On the contrary it makes it possible by requiring of liaison only what it can give. It puts us on our guard against the breaking up of artillery as the result of too narrowly comprehended liaison through the lower ranks, a breaking up which was overdone during the last war.

APHORISME XXX

In humane actions, small actions work great effects, and especially in those of War; for one word of command mis-understood, many times overthrowes both the action and the Actors. Wherefore a wise Generall should accustome his Souldiers to the perfection of discipline, never to take allarme, or apprehension of suddain danger from what others doe, or say; but from his own immediate Officers, or them in place about him.—
Ward's Animadversions of War *(London, 1639).*

EDITORIAL

Coast Artillery Training

IN a recent letter to the editor, one of the senior officers of the Army suggested that Coast Artillery training would be improved if Coast Artillery commands functioned more frequently as a whole—somewhat like the Navy in battle practice—with all guns at work and the entire fire control system in operation. Moreover, he believed that such practice should take place at night, as being the most probable time at which enemy vessels will attempt to run by. The idea is that, no matter how well we may serve individual guns or separate batteries, the command cannot function satisfactorily as a whole without practice in teamwork—in coordination and cooperation.

He is, of course, entirely correct and is expressing the old idea of battle practice. No team can work smoothly and efficiently until it has practiced as a team. No officer can doubt the desirability of battle practice by groups of batteries, but any Coast Artillery officer can name half a dozen reasons which might cause us to pause before ordering practices on a large scale under present conditions—the difficulty of simulating a number of warships with targets that may be fired upon, the low speed of available towing vessels, the necessarily limited amount of ammunition which may be fired, uncertainty as to the probable aerial conditions to be encountered in actual engagement, the demands of record keeping, the question of identification of splashes in concentration of fire, the complexity of fire control and fire direction at probable ranges. Although the list is long, it is being reduced, for some of the objections which could be raised in the years immediately following the World War no longer exist. That more difficulties have not been removed by this time may not be to our credit; but, since they are still with us, many of them will be encountered in actual engagement and may therefore be put forward as arguments for consolidated practices. Not to them, then, can we charge the inexpediency of substituting group practice for battery practice at the present time.

In matters of technique the Coast Artillery is in good shape. We know the limits of accuracy of our guns. We can place a battery center of impact reasonably close to a target. We are aware of the weaknesses and the deficiencies of our materiel, and we are accustomed to impro-

visation where necessary. In other words, we are prepared to serve our weapons effectively within the limitations imposed upon us by our materiel, and we are therefore prepared to take up practice under battle conditions. But what are those conditions to be?

It is here that we find a lack of *unanimity of thought that must* make us pause. Our pre-war conceptions of coast defense have gone "by the board" and we have outlined a new system. In outline, our present scheme appears to be simple and to conform to the accepted principles of war; but in detail—particularly in the details of the employment of artillery—the positive system of coast defense remains vague. Some points have been settled and some are nearing a solution, but many yet remain for consideration. As a starting point—just when does a harbor defense command pass from the Zone of the Interior to the theater of operations? What effect does the change have upon the chain of command? What influence, if any, does the presence or absence of elements of the mobile army have?

When it comes to the employment of seacoast artillery in action, what will our tactics be? Do we concentrate our fire? If so, where? Who is going to control the fire of our guns? What will be our tactical chain of command? Is any distinction to be made between fixed artillery and heavy mobile artillery in matters of employment? What becomes *of the battalion and regimental commanders in the war* organization? Of the fort and harbor defense commanders? Have we, at any time, an "independent rôle"? In fine, just what is the relation of the Coast Artillery to coast defense?

The Coast Artillery is beginning to show evidence of crystalization of opinion in regard to its function in coast defense, but, until we know the answer to many questions it is obvious that group practice should be approached with caution lest we introduce unsound doctrines. We can now try out combined target practices in a small way with a view to overcoming our technical difficulties, but we can scarcely hold "war period" practices until we are reasonably certain that the conditions we impose as representative of war conditions are, in fact, so representative.

PROFESSIONAL NOTES

The Fourteenth Coast Artillery (H. D.)

The Coat of Arms of the 14th Coast Artillery was approved by the War Department on November 18, 1924, and is blazoned as follows:

Shield: Gules (red) two flaunches ermine.

Crest: On a wreath of the colors (gold and red) the head of a northern lynx caboshed proper (in natural colors).

Motto: Semper Vigilans (Always watchful).

The regiment was organized in the Coast Defenses of Puget Sound, and the shield is taken from the Coat of Arms of these Coast Defenses. The red is for artillery. The flaunches of ermine recall "Astoria" and its fur trade in the early days and by their outline on the shield indicate the contour of the straights. The large gray northern lynx is characteristic of the country and the motto is truly military.

The crest and motto on a scroll are worn by the personnel of the regiment as their distinctive regimental badge.

The 14th Coast Artillery was organized in 1924 and the history of its units is as follows:

Headquarters Battery was organized in 1901 at Fort Lawton, Washington, as the 106th Company, Coast Artillery; designated the 4th Company, Fort Worden, in 1917, and 4th Company, Coast Defenses of Puget Sound, in 1917; again designated the 106th Company, Coast Artillery Corps, in 1922; and became Headquarters Battery, 14th Coast Artillery, in 1924.

Battery A, 14th Coast Artillery, was organized in 1901 at Fort Williams, Maine, as the 108th Company, Coast Artillery; designated the 5th Company, Fort Worden, in 1916, and 5th Company, Coast Defenses of Puget Sound, in 1917; again named 108th Company, Coast Artillery Corps, in 1922; and became Battery A, 14th Coast Artillery, in 1924.

Battery B, 14th Coast Artillery, was organized at Fort Flagler, Washington, as the 94th Company, Coast Artillery; designated the 3d Company, Fort Flagler, in 1916, and 15th Company, Coast Defenses of Puget Sound, in 1917; was absorbed by the 13th and 14th Companies, Coast Defenses of Puget Sound, in 1919; reconstituted and designated the 94th Company, Coast Artillery Corps, in 1922; and became Battery B, 14th Coast Artillery, in 1924.

Battery C, 14th Coast Artillery, was organized in 1901 at the Presidio of San Francisco as the 92d Company, Coast Artillery; designated 2d Company, Fort Flagler, in 1916, and 14th Company, Coast Defenses of Puget Sound, in 1917; again became the 92d Company, Coast Artillery Corps, in 1922; and designated Battery C, 14th Coast Artillery, in 1924.

Battery D, 14th Coast Artillery, was organized in 1901 at Fort Wadsworth, New York, as the 85th Company, Coast Artillery; designated the 2d Company, Fort Casey, in 1916, and 10th Company, Coast Defenses of Puget Sound in 1917; again became the 85th Company, Coast Artillery Corps, in 1922; and designated Battery D, 14th Coast Artillery, in 1924.

Battery E, 14th Coast Artillery, was organized in 1901 at Fort Stevens, Oregon, as the 93d Company, Coast Artillery Corps; designated the 3d Company, Fort Stevens, in 1916, and 3d Company, Coast Defenses of Columbia, in 1917; again became the 93d Company, Coast Artillery Corps, in 1922; and designated Battery E, 14th Coast Artillery, in 1924.

Battery F, 14th Coast Artillery, was organized in 1907 at Fort Casey, Washington, as the 149th Company, Coast Artillery Corps; designated the 3d Company, Fort Casey, in 1916, and 11th Company, Caost Defenses of Puget Sound, in 1917; again became the 149th Company, Coast Artillery Corps, in 1922; and designated Battery F, 14th Coast Artillery, in 1924.

Battery G, 14th Coast Artillery, was organized in 1907 at Fort Worden, Washington, as the 150th Company, Coast Artillery Corps; designated the 1st Company, Fort Ward, Washington, in 1916, and 16th Company, Coast Defenses of Puget Sound, in 1917; again became the 150th Company, Coast Artillery Corps, in 1922; and named Battery G, 14th Coast Artillery, in 1924.

Battery H, 14th Coast Artillery, was organized in 1901 at Fort Worden, Washington, as the 126th Company, Coast Artillery Corps; designated the 6th Company, Fort Worden, in 1916, and 6th Company, Coast Defenses of Puget Sound, in 1917; absorbed by the 5th Company, Coast Defenses of Puget Sound, in 1919; reconstituted and consolidated with the 12th Company, Coast Defenses of Puget Sound, which had been organized in 1921, and designated the 126th Company, Coast Artillery Corps, in 1922; became Battery H, 14th Coast Artillery, in 1924.

Battery I, 14th Coast Artillery, was organized in 1901 at the Presidio of San Francisco as the 115th Company, Coast Artillery; designated the 2d Company, Fort Rosecrans, California, in 1916, and 2d Company, Coast Defenses of San Diego, in 1917; became Battery A, 65th Artillery, Coast Artillery Corps, in 1917, and participated in the St. Mihiel and Meuse-Argonne offensives in 1918; disbanded in 1919; reconstituted and consolidated with the 2d Company, Coast Defenses of San Diego, which had been organized in 1921, and designated the 115th Company, Coast Artillery Corps, in 1922; became Battery I, 14th Coast Artillery, in 1924.

Battery K, 14th Coast Artillery, was organized in 1907 at the Presidio of San Francisco as the 160th Company, Coast Artillery Corps; designated the 2d Company, Fort Stevens, Oregon, in 1916, and the 2d Company, Coast Defenses of Columbia, in 1917; redesignated the 160th Company, Coast Artillery Corps, in 1922; and became Battery K, 14th Coast Artillery, in 1924.

Foreign Periodicals

UTILIZATION OF WAR EXPERIENCES.—Following is a translation of an article on this subject by an unnamed writer in the October 11, 1926, number of the *Militär-Wochenblatt* that contains some points on the subject of "War Experiences" generally that are worthy of notice.

"Not every participant in the war is in possession of war experience. It is only when the observations made in the war are correctly recognized and properly construed in their relation one to another that there can be a question of experience. But frequently a preconceived opinion influences judgment without the observer being aware of the fact and thus renders it difficult or wholly prevents him from divesting himself of faults and deficiences. But when a strong mentality takes hold even after a brief test of his experiences great things may be

quickly accomplished. Thus Frederick the Great learned how to reorganize and remodel his cavalry, after it had proven to be a complete failure at Mollwitz, in such manner that it decided the victory four years later at Hohenfriedberg by its bold attack against numerically superior cavalry and infantry. In like manner Scharnhorst contributed largely to overcoming Napoleon by the reorganization of the Prussian army by measures undertaken by him after 1806. As was the case with the Prussian cavalry in 1741 so did the artillery bring a great measure of disappointment on the Bohemian battle fields in 1866. It was not easy to gain a correct conception of the causes of the artillery's short-comings, for only two years previously the effect of its rifled cannon on the Kimbrian battle fields had been so surprising to the world in general that the Italian general Govore, present as an observer at Berlin, declared the Prussian artillery to take very first rank in the world. The causes of defection were due in large part to the artillery itself only and in greater part to the extraordinary superiority of the Prussian infantry armed with the needle gun over the Austrians using a muzzle-loading rifle and antiquated infantry fighting tactics. The superiority was so great that the Prussian infantry did not need the assistance of the artillery at all and did not wait for such assistance but attained its purpose by bold attack. Fortunately the artillery, at whose head stood the energetic General von Hindersin, who was undaunted by any difficulties, was not content with this explanation but sought and found in itself the prevailing defects and removed them as far as possible. The artillery was deficient in its most important element: *it couldn't shoot!* Hindersin called the artillery firing school into being; the artillery were ignorant of the fighting methods of the infantry because artillery officers had, at all maneuvers, never been used as commanders of combined arms. He succeeded in bringing about correction of that practice. In spite of opposition almost incomprehensible today the armament of the entire field artillery with rifled guns was put through by him with great energy. New principles in regard to utilization of artillery that permitted timely intervention of artillery in the fight were also introduced. Hindersin found a distinguished fellow worker in Prince Hohenlohe who was an interesting writer on field artillery subjects in his well-known letters. The great successes of the German artillery in 1870-71 furnish abundant evidence of the accurate valuation and application of the experiences that had been gained by the artillery under Hindersin's teachings.

"War experiences had seldom been utilized in such original manner. That is shown, among other incidents, by the French artillery which, dazzled by the success of its rifled guns in the Italian campaign, permitted the following years of peace to pass away without making further effort, even though the great effect of breech-loading guns in the German-Danish war gave out lessons that were clearly aparent to every intelligent observer. It was for us very fortunate that the French attributed the non-success of the Prussian artillery in the war of 1866 to defects in the breech-loading guns and not to their erroneous employment. The Austrians also failed to make correct use of their observations in the war of 1859; they believed that the successes of the French were attributable to their bold and energetic attacks in strong columns, and forgot that what might be permitted against the heavy muzzle-loading rifles must lead to annihilation against the rapid-firing breech loader. This is more surprising because they fought side by side with the Prussians in 1864 and could there have seen how the latter achieved successes with such slight losses.

"These examples show in how many different ways war experiences are turned to advantage according as they are influenced by preconceived opinions or not. In regard to the war of 1870-71 it is sufficient to state that both sides were earnestly and successfully engaged in utilizing their observations and experiences. But they were in part forgotten or ignored in the long period of peace; among them was, above all, that during and immediately after every war the effect of artillery has been given extraordinary value; after an approximate peace interval of twenty years one began to estimate mobility at the expense of fire effect.

"The experiences gained in the World war embrace all spheres and are so manifold that a single individual cannot enumerate, to say nothing of duly appreciating, them. We will here discuss only one question which, in my estimation, has been switched to the wrong tracks. The German infantry has complained—whether justly or unjustly is not considered here—that it had not been adequately assisted by our light artillery and had deduced therefrom the conclusion that our light artillery was inferior to the French. That has been declared by the other side to be a legendary myth.

"This controversy is useless because it is less important to show that one or the other artillery was superior than it is to establish the fact whether or not the complaint of the infantry was justified and if so what is the remedy for that conclusion. The question regarding superiority can not be easily solved because there are many things that would come up for comparison one with another, for example: armament, organization, training, application, etc. An artillery may have superiority in any one of these elements and be inferior in another. But he who desires to make a comparison must guard himself against any preconceived bias or prejudice and especially against erroneous information, because by that he would reach a result contrary to his intentions.

"Thus it is wrong to assert that the French had preferred the defense to the attack and had thereby favored their artillery. The French General Herr says, on the first page of his well known work *The Artillery, Past, Present, and Future:* 'Our instructions emphasize in the strongest manner the exclusive value of the offensive.' As an actual fact the French artillery regulations of 1913 say: 'The defensive may be brought about by circumstances or forced upon us by the opponent. It must be assumed only temporarily and entered upon with the fixed determination to resume the offensive at the very first opportunity.' The infantry regulations declare: 'Passive defense leads to assured defeat and must be unalterably rejected. Only an active aggressive defense brings success.' As an actual fact the French proceeded everywhere to the attack immediately after their approach march.

"The assertion that the somewhat larger caliber of the German field gun had an advantage over the French 75-mm. cannon is wholly erroneous. The exact contrary is a fact. The larger caliber would have had the greater effect if it had fired a heavier projectile, but notwithstanding the two millimeters less caliber the French gun fired a projectile 0.4 kilograms heavier, with greater velocity and less cross-section resistance, and had, in consequence, greater force of impact and effect at the target. It is the weight and not the diameter of a projectile that gives the measure of its effect.

"The great range of the French guns had been mentioned as a special advantage. It is very properly stated that the French as well as we had, before the war, given thought to greater firing effect at extreme ranges. With the high ballistic achievements of their guns—great initial velocity, weight of projectile, and dim-

inished cross section resistance—the French directed their attention not to extreme ranges but rather to decisive effect at customary fighting ranges and that is throughout a correct conception. Whoever endeavors to attain the greatest possible effect at those ranges gains by that very effort an extended range; he who strives for an effect beyond that measure must take into account a forfeit of effect at the decisive ranges.

"The assertions in regard to extreme ranges are not conclusive. The limit of elevation of the French gun is, according to the firing table before me, + 18 degrees (not 14 degrees) and corresponds to the range 6800 meters, that is also reached with shrapnel time fuzes (and not 5500 meters, as has been there stated). The extreme range of the French cannon is 8500 meters (not 8800); that of the German F. R. 96 n/a is 7800 not 8500 meters.

"The greater weight of the French gun in the firing position and the retardation in opening fire due to the necessity of the *abatage* [bringing the gun down to the position of 'load'] cannot have been felt to any great extent, because the frequent change of position of French guns is mentioned by a number of German writers.

"The differences in achievement of the several guns—General Wrisberg gives the effect of the French guns as not perceptibly greater—are, in my opinion, not such as to furnish a satisfactory explanation for the complaints of our infantry. If those complaints, which have also been raised by the French infantry, are justified, the cause is without question the inadequate combination of the two arms. And that gives us opportunity and occasion to '*insert the crowbar into the crevice.*'

"To accomplish that it is necessary to follow up those complaints, as has been done so thoroughly by the French General Percin in his book that appeared in 1921 on '*Le Massacre de notre Infanterie, 1914/18.*' He confines his investigations to cases where the artillery, according to evidence furnished, fired upon their own infantry. But the question under consideration here is by no means conclusively answered by that. Percin mentions 200 such cases with most accurate reference to place, date, and identification of the troops fired upon. He seeks, not like the agent of justice, for the guilty party, but, like the philosopher, for the cause. I refrain from going into details but earnestly recommend to officers who desire to discuss such questions, study of the book. They can learn from it how the complaints of the infantry about inadequate assistance of the artillery are to be met. The artillerist can require *that the complaint shall be based on accurate data,* as given in the work above referred to; then only will he be in a situation to investigate and decide whether the cause was defective or inadequate instructions of the artillery leader, (*liaison par le haut,* as Percin expresses it), or to the fact that there was inadequate combination between the artillery assigned to assist the infantry itself (*liaison par le bas*).

"In conclusion I desire to suggest certain ways in which the cooperation of the two arms may, if not fully attained, be at least facilitated. One method lies in frequent changes of commanders, or even transfers of officers from one arm to another. The first, as is well known, occurred with us at the conclusion of periods of instruction at the war college, but was, unfortunately, applied only to junior officers who had but slight influence upon their comrades. Another is the assignment of higher officers to attend the firing exercises of the artillery school. That occurred shortly before the war but produced only a slight effect because those officers attended the exercises as observers only. Only when they are assigned

as actual active participants, that is when charged as commanders of assumed troops present based on a fighting situation laid out before them, can any useful result be expected from such measures. I will not omit allusion to a proposition that appears to me well worth attention which is set forth by Lieut. Colonel Vernay in his book, *Intelligence Service*, under the section: 'Building up the artillery net of the Division' by means of which an enduring connection between artillery and infantry is to be assured.

"Even he who, like General Wrisberg, admits the superiority of the French 75-mm. cannon does not detract from the merit of our troops; that can only be added to. It is not a question of lifeless implements but of the inherent spirit that pervades the troops."—G. R.

FUNDAMENTAL PRINCIPLES AND SPIRIT OF FRENCH, ENGLISH, AND GERMAN FIGHTING REGULATIONS OF TODAY AND SOME OF THE REASONS FOR THEIR DIVERGENCES.—The August 6 and 13 issues of the Austrian *Wehrzeitung* contain an interesting discussion of this subject, written by Major Rendulic of the Austrian army, a synopsis of the salient features of which is here given.

Introduction.—When we observe the fighting regulations of various armies of the ante-war period we find a far-reaching unanimity of views, not only in their fundamental principles but also in the preponderating mass of their details. The reasons for this uniformity of opinion are various. Nearly two generations were available for exploitation of the most important sources of information—the war of 1870-71. During this long interval the mutual acceptation of impressions tended finally toward compromise and agreement among several armies. The comparative progress made in the development of the technique of armament and finally the military political circumstances of the nations concerned were, to a certain degree, similar. Nor was this uniformity of views materially influenced by utilization of the last sources of information that came into consideration before the World war—the Boer war in South Africa and the Russo-Japanese war.

But after the World war, conditions in this respect were greatly changed. The fighting regulations that have been prescribed for the most important armies since the World war indicate decided departures in many fundamental practical questions. There are also manifold reasons for this departure. Above all we have the established fact that the World war showed a wholly unanticipated development of the technique of armament and furnished consequential unusual complications in the directive conduct of the fight, stimulated to a great extent by the introduction of the air arm and the tank. As complications in fighting directions are increased, the necessity for more details in fighting regulations are correspondingly increased and the sum of departure from uniformity of views grows with increase in the number of details.

But the political and military situations of the nations concerned are, in the end, the most important causes of variations that find expression in framing fighting regulations. Thus we have in France a state whose population is manifestly in disproportion to the strenuously attempted rivalry for precedence in power among the nations of Europe. Its wants of confidence in its own strength, based in part on its decreasing population and to a larger extent on the loss of its Russian ally, induces this state, with its unlimited material equipment, to place special emphasis on fighting machines that appear to afford a methodical means of conducting fighting operations. These are apparent in the details that find

expression in French fighting regulations. Another series of most general differences between regulations manifests itself in its outer form in causes due to the military political conditions of the three states and in the tactical views prevailing therein. We will not be in error when we discern the keynote of recognition of tactical views in the rôle of importance that a regulation gives to fire as a fighting means. The position given to the infantry, that is to the arm that does not fight with machines exclusively, is an indication of the intimate reliance given to the value of fire effect and is really its emphatic expression.

French Fighting Regulations.—Even though the importance of moral factors and of their cultivation is repeatedly emphasized in numerous special instances in French fighting regulations, this frequently gives rise to the impression that it is a consequence of the necessary corrective of the more decided emphasis accorded to the fighting instruments.

Of the three main forms of fighting treatment of the war of movement, the encounter battle, the attack, and the defense, the French fighting regulations recognize in reality the last two only. They accept, as an arbitrary rule, that when two opponents are marching toward each other one of them will begin, in advance, to decide upon the defensive under conditions that he will assume to be to his advantage. The opponent continuing in the offensive will, sooner or later, encounter an enemy in position for defense against whom his attack will have to be developed on a more or less scheduled plan. The transition from attack to defense will come about only in one of the forms reverting back to the war of position, namely: when it becomes a question of holding conquered terrain.

It is also a marked peculiarity of the French regulations that they give most emphatic tone to stimulative fire effect—one of the most prominent manifestations of the World war—whose consequences asserted themselves in the domain of strategy as well as in that of tactics. They hold that the fire screen of the defender can be penetrated only by an organized attack for which favorable conditions can be brought about only by the combination of powerful auxiliary material means—artillery, tanks, ammunition. The attack, therefore, requires a preliminary preparation of a corresponding period of time and its accomplishment will, on account of the necessity of continual renewal of the advance resulting therefrom, reveal manifold interruptions. Fire effect, even in the depth of the fighting area and in the extension of this depth caused by the air weapon, leads to a rapid exhaustion of the troops so that care for replacements will play an important rôle in the arrangement of plans of operation.

Fighting machines and the demands for their effect are matters that exercise a preponderating control over discussions bearing upon French regulations. The problems of the infantry whose activities lie within that domain are expressed in substance by: "the infantry captures the terrain, occupies, arranges, and holds fast to it." But this does not appear to coincide with the spirit of the regulations which hold "that the principal task in the fight falls to the infantry." This "principal task" has, at any rate, a corresponding light thrown upon it in the sentence first quoted above. Only a subordinate importance is imparted to the shock of the living force of the infantry. Of the two elements of the infantry fight—fire effect and mobility—the preponderating measure of significance is accorded to mobility: "always get nearer to the enemy in order to carry a powerful fire effect against him that will break his resistance." Even though the regulations may not say so in words, they count on most intimate cooperation of the artillery, especially in the

attack. The organization of artillery activity is, under the French regulations, a skillful structure in respect to independence from or subordination to the infantry leadership, according to the prevailing fighting situation. The regulations also leave room for the inferential impression that the hand-to-hand encounter with cold steel is very exceptional and that the infantry assault will, in the end, resolve itself into nothing more than occupying and cleaning up the enemy's position.

English Fighting Regulations.—England has, since the end of the war, returned to its traditional policy of a professional army and must, notwithstanding its numerous military-trained youths, throughout the country, rely, in case of war, upon a large number of sparely-trained fighting forces that can in the beginning naturally master the technique of modern fighting methods to a limited extent only. But the fruit of intensely cultivated sporting activities participated in by large circles of the English population, in addition to the physical fitness of its citizens, which aid in creating and strengthening moral factors, are of value for its military purposes. It is therefore not surprising that English regulations—with but slight exceptions—avoid every appearance of intricate complications and give precedence to sane conceptions of human understanding of that which is pertinent to the question at issue, and put into the background systematic devices. They clothe the moral momentum less in forms of demands than does the French regulation, but make of it an essential, practical element of fighting conduct and incorporate it organically in a very skillful manner into the fundamentals of fighting directive. They place, at the head of their recital, the sentence: "neither numbers nor armament nor skill make up want of courage, force of action and determination and boldness of spirit of attack that proceeds from the national will to conquer." They do not, by any means, underestimate the significance of materiel but they do not attribute to it the super-excellent influence in the fight that the French give to it. They give to the leader the possibility to ignore, where circumstances permit, the shackles of material requirements in favor of the moral value of the troops. The time-wasting organization for the attack that must be expected by the French system even in the encounter fight, for which they provide no special instructions, is demanded only for the attack against an enemy in position for a systematically planned defense. In the defense the strength of a position depends less upon the favors of the terrain than upon the morale of the troops. The effect of fire, which can achieve success only by utmost cooperation of all arms, is not placed on as high a scale as it is in the French regulations. It is, in the English, stated as a fundamental fact that fire alone will rarely ever force a determined troop out of their defensive position. To drive the enemy from the field demands the assault or the threat of it. It is, therefore, quite a natural conclusion that the English regulation fixes the place of the infantry with the words: "the infantry, in the end, gains the battle."

German Fighting Regulations.—During the World war the Central Powers were subjected to great restrictions for want of materials. That occasioned great differences in fighting conditions on account of the increasing importance of material and the fact that our opponents had at their disposal the material resources of the whole world. The skill of our leaders, the moral force of our fighters, and numerous auxiliaries, devised as substitutes, were required, on our side, to defy the preponderating might of material; this is even today a sequence characterizing the German regulations when contrasted with the French.

The fundamental principles heretofore mentioned as controlling elements in English fighting regulations are manifest in even greater measure in the German. The authors of those regulations, who were obliged to take into account restricted means and improvisations of all kinds, had no room for set, blank-form schedules. In the German army the method of conducting a fight even by smaller units involves a system of incessant aid and solicitous adaptation to prevailing circumstances. It is self-evident that under such restrictions great weight must be placed in all fighting actions upon the personality of the individual fighter, his fighting value, the personality of his leader, the stimulation and the strengthening of his spiritual forces. The manner of accomplishing these requirements is embodied with great skill in the fighting regulations.

The German regulations follow to the end in parallel direction the essential developments outlined in the English. We find in them all forms of conducting a fight that may appear in the war of movement given equal care. Attention is also given to conditions in the war of position in separate sections.

According to the German regulations weapons and material are not in themselves the ends of success in the fight but the means for attaining it. In the final test it is the man who carries the fight. The significance of the man for the fight, of the spirit that animates him and the moral fibre that is inherent in him, is the guiding thread that pervades all German regulations. The enemy is also given recognition and valuation in this sense. This is very clearly perceived in the estimation given to fire effect, since the regulations assume, as a rule, that the defender cannot be subdued by fire alone but the attacker must resort to the assault. "Infantry brings the decision in the fight" is the most incisive expression of the German regulations.

In respect to artillery participation the German regulations place great weight upon independence of action of artillery leaders, even of those of a minor grade, and demand from them the utmost exertion of their spiritual and moral forces to the utmost limit to effect efficient cooperation with the infantry and utilization of the fighting machinery at their disposal, according to the prevailing fighting situation.

Conclusions.—The characteristics indicated in general form in the foregoing remarks on the fighting regulations of the different armies there referred to disclose very important reasons for the differences in the fundamental establishment of these regulations for methods of conducting fights. Numerous departures from them in matters of a minor nature are inevitable. But even where the fundamentals set up in the regulations appear to coincide in substance we find departures in the manner of their adaptation and in the treatment of the matters that are essential to a proper conception of their basic principles. And here there arises the very important fact in regard to the extent to which these regulations could adapt themselves to the limits of the one-sided biased experiences of the World war of position.

The characteristics of artillery, as a summary of fighting machinery, finds numerous expression in all three regulations. French regulations see the possibility of its most potent success in a unanimity of leadership of the artillery and the English and German regulations confirm this indispensable precept. But while the French regulations stand by this maxim and consider subordination of artillery to infantry units as rare exceptions and make only slight reference to the use of artillery, the English and German regulations count upon numerous occasions for the necessity of such subordination in the interests of complete efficiency.—G.R.

The Profession (?) of Arms

EDITOR'S NOTE.—The following article by Mr. W. S. McWilliams is reprinted from the *Evergreen Chatter*, a semi-monthly published at Loyola college (Baltimore), of which Mr. McWilliams was editor-in-chief. As it represents a viewpoint from without the military service, it will be of interest to JOURNAL readers.

It has come to our notice lately that someone has started an argument. This is the question, "Should an Army officer be classed in the professional ranks?" It is, we think, a question worthy of editorial comment.

To say yes would be wrong; to say no would be wrong. We must distinguish. The officered personnel of certain branches of the service have a very legitimate right to a professional status. The officers of the Medical Corps are graduate doctors, the officers of the Judge Advocate General's Department are full-fledged lawyers and the officers of the Chemical Warfare Service are accomplished scientists. In these branches of the service the officers receive their professional training in just the same manner that any civilian would and in most cases prior to their entering the service.

In the other branches the qestion is not so easy to answer. This much should be granted, however, that at some certain grade an officer is entitled to a professional status. But who shall say what this grade is to be? Certainly not the grade of second lieutenant. Let us take the case of a young man entering the Military Academy at West Point. He enters from high school and receives four years' training at the Academy. About two-thirds of this training is average collegiate work, the other third is fundamental military training. Granting that he passes all of the eximinations, at the end of the four years he is commissioned as a second lieutenant in the Regular service. Now to grant this young man a professional status would certainly be a rank injustice to the recognized professions.

Let us follow him further. If he chooses as his branch the Engineer Corps, he would probably be entitled to a professional status upon reaching the grade of first lieutenant, which he could not attain in less than five or six years. By that time his engineering knowledge would be equal to that of any newly graduated civil engineer. At the grade of captain he would surely be entitled to it. The same would hold true if he had chosen the Signal Corps, where the professional equivalent would be electrical engineer. If he had chosen the Air Service his status would be a bit doubtful, although there might be an equivalent in aeronautical engineer. However, as he advanced in rank he would find an equivalent somewhere in the mechanical sciences, because his work would be intensely scientific and highly specialized. Contrary to public opinion, the ability to fly an airplane does not make an Air Service officer any more than the ability to ride makes a cavalry officer.

If he had cast his lot with the line, Infantry, Cavalry, Field Artillery, and Coast Artillery his status would become even more doubtful, with the exception, possibly, of the Coast Artillery, whose work is very technical. Let us suppose that he had picked the Infantry. His job here would be to personally lead combat troops, fighting men. This job is the only one of its kind in the world, but not of a nature to endow him with professional dignity. It is the opinion of the writer that an infantryman does not enter the professional ranks until he has reached the grade of major. Inasmuch as the Infantry, in the end, is the most important element of an army, such a statement may seem to strike a false note. But let us consider. The infantryman is the true soldier. His lessons are hard, comprehensive and empiric, and are only thoroughly learned in the school of

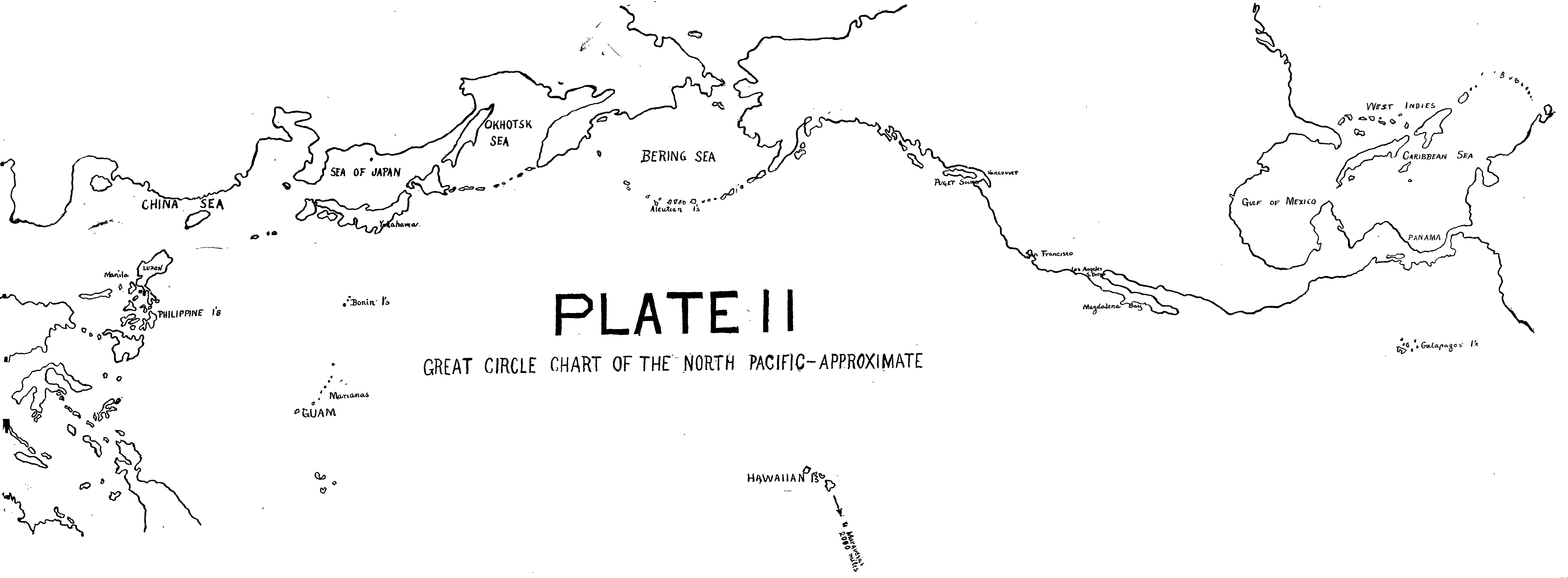

PLATE II

GREAT CIRCLE CHART OF THE NORTH PACIFIC–APPROXIMATE

actual warfare. Proficiency in his calling is attained only after years of actual service with troops. The prosecution of a successful war calls for the use of all a man's energy. It is the hardest job a human being ever tackled. To accomplish it successfully he must be physically fit, mentally alert and he must know his job. And in wartime, the job of a major of infantry is truly a man-size job. It does not seem just to deny such a man the privilege of calling his job a profession. In much the same way this applies to the Cavalry and the Field Artillery. The nature of the Coast Artillery's work is very technical and involves the defence of the coast. At what grade the officers of this branch attain professional dignity is had to say, but it is probably not under that of captain.

Someone now asks the question. What about the Navy and Marine Corps? The writer knows very little about either arm and would not like to say. It is, however, not improbable that a parallel could be drawn. The writer well understands that this article will be believed and disbelieved, approved and condemned and probably much discussed. At any rate, the profession of arms has always been an honorable one and for the most part officered by gentlemen.

The Discipline of Details

By CHAPLAIN MILTON O. BEEBE, U. S. A.

That which makes an Army out of a mob is discipline. That eminent German militarist who stated that the armies of the North and the South in the Civil War were but armed mobs was only playing to the galleries. He was creating sentiment for Germany out of a fabric of lies. The splendid discipline of both armies, in the days of our civil strife and dissension, was sufficient proof of their efficiency. The proud Bismark would have been glad to command the men of either army.

Discipline is very difficult to secure in an army. It is not a commodity for sale in the open market, nor can it be manufactured, save from the devotion and patriotism of the men who make up our armies, and that by a slow, laborious process of constant care and persistent work. As an eminent British soldier writes, "Discipline is an instant and willing obedience to all orders, and in the absence of orders, to what you believe the order would have been." Taking this as a sound definition and following it to its source, we find that discipline is taught in every drill, every inspection, every day's fatigue, every parade—indeed, in every moment of service.

Let us know, at the very beginning, that discipline is not punishment alone. We speak of "disciplinary measures." Sometimes the authority of courts-martial must be invoked to obtain discipline. That, however, is for the exceptional soldier —the obstreperous, obstinate individual. It is not the rule.

Neither is it possible to say that praise and commendation alone form discipline. When a man does well he should know it. Strong letters of commendation are valuable aides to discipline in a command when commendation is deserved. However, discipline is more than commendation.

Again, a discipline of force, such as existed in the German army during the war, is not discipline as we desire it. That is the discipline of autocracy, where officers lash their men across the faces if they do not stand properly and precisely at attention, and where they send their men to death with their own pistols if they fail to make a proper advance. America must have a better discipline than this if her army is to be worthy of the name—a discipline of democracy, a willing and cheerful obedience to proper authority on the part of every soldier. Just

a casual review of the qualities that go to make up the average American will convince one that he is more difficult to discipline than the soldier of any other nationality in the world.

The very fundamental principles of our country—freedom and equality—make discipline in our army a difficult thing, though we would not change these principles if we might.

Every young American has been so long considering himself the equal of every other person—and he is—that it is difficult to get him seriously to consider authority. He has been his own "boss," doing as pleased his imperial self, and it is not an easy thing to get him to see that in the army he must please others as well as himself. The only discipline we wish from such men—they are the finest in all the world—is a discipline of democracy that has its source in common sense, pride, and patriotism. We do not want very much from Germany, least of all its military discipline, but we do want a discipline with sufficient force back of it to accomplish what we set out to do.

Back of every effort to train and discipline an army properly is preparation for battle. The undisciplined army will not fight because it does not know how. It is the properly organized, trained, and disciplined army that fights like a fiend and brings home the victory. Therefore the army without discipline is only a mob. It never gets any place, and in a possible engagement suffers the heaviest casualties.

In the army, the beginnings of discipline are the beginnings of success. The former leads directly to the latter. There can be no success to our army or to any other, except it first come in discipline.

There is a peculiar regard, in our army, for inspectors general, because they have an uncanny sense of non-uniformity and laxness in detail. They require that every man be dressed like every other man to the smallest detail; that every rifle be perfect in its performance and mechanism; that every Liberty truck be perfect in appearance and performance; that every private, corporal, and sergeant be perfection itself in appearance and functioning. If their requirements are not carried out, they are very free to send in a severe and extensive "skin list." Why? Largely for disciplinary reasons; and that is enough in itself. They, and all others, know that uniformity and exactness, very worth while as ends in themselves, assume an overpowering importance as factors in discipline.

To send men into the thick of any fight without training and discipline effects the loss of both the cause and the army. To expect men to fight like veterans without training and discipline is like asking an infant to construct a railway locomotive. It isn't done.

So we conclude that discipline, in our Service, is of prime importance.

I have mentioned the discipline of democracy that has its source in common sense, pride, and patriotism. It is a discipline of detail. Viewed in this light, the proper performance of every task from reveille to retreat becomes of importance as a factor of discipline. Let a company become so proficient that the men can go through the entire manual of arms without an error, and you have an organization with unlimited possibilities in both offensive and defensive work because it is disciplined. Every "squads right" and "pass in review" makes for discipline. Every artillery drill, where a degree of perfection is even approximated, makes for discipline. So does every hour of fatigue and wholesome recreation properly indulged in help in the training and make for discipline of the soldier because it concerns the details of his life. In the final analysis, discipline is a matter of

detail; and it covers the whole range of military interests from cotter-pins to hits-per-gun-per-minute.

There can be but one effect of discipline—efficiency; and inefficiency is the boon companion of laxness and lack of interest in detail.

We wonder at the interest displayed by officers in very small matters on the occasion of inspections. They seem entirely insignificant. No so! The officers are not concerned with these small matters in themselves. A soiled uniform, a dirty bayonet, some dirt under a bunk would be trivial matters if they were not related to efficiency. They are only details, for "He who is faithful in a few things is also faithful in much." It is proverbial that if we care for the dimes, the dollar will take care of itself. In the discipline of thrift, we begin by being careful about the pennies, nickels, and dimes. In the discipline of details, we begin with soiled uniforms, uncleaned rifles, unswept barracks, unshaved faces, unpolished shoes, and go from these to the greater and more important points of technical training in our profession.

Efficiency is based on a discipline of detail. It must be so. To disregard these things would be fatal to us as an army. The men who appear well at inspection, close order drill, artillery drill, fatigue, recreation, are the men who are efficient in the big things, and who can be counted on in any and all emergencies. They are efficient soldiers because they are properly disciplined.

Determination of the Muzzle Velocity of Projectiles

By Colonel Pouleur, *French Army*

Extracts translated by Captain A. M. Jackson, C. A. C., from the *Bulletin Belge des Sciences Militaires*

1. This determination is a common occurrence in artillery boards of investigation; modern ballistics require, in fact, a knowledge of the muzzle velocity of each projectile fired with a view to the establishment of firing tables. Besides this, each lot of powder should be tared, that is to say, that the weight of powder charge giving the tabular muzzle velocity should be sought in practice.

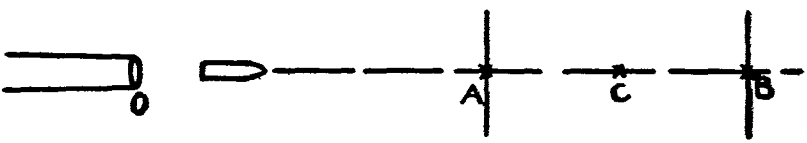

Fig. 1

2. *Principle of the method.*—In order to know the velocity of V_o we measure the time t necessary to a projectile to traverse the known distance AB $= a$ (fig. 1); we assume then that the velocity v at C, the middle point of AB, is equal to $\frac{a}{t}$; we pass from the velocity v at C to the initial velocity V_o at the muzzle O by exterior ballistics formulae.

3. *Apparatus generally employed for the measurement of the time t.*—The projectile arriving at A and at B breaks electric wires placed in screen-targets and these wires are connected to chronographs; the LeBoulengé—from the name of the Belgian artillery officer, their inventor—are those most generallly employed. They have received numerous improvements as to details and the LeBoulengé-Bréger are instruments of high precision.

4. *Precision of the LeBoulengé-Bréger chronographs.*—The precision of the velocity measurement depends not only on the measurement of t, but equally on the measurement of the distance a, and LeBoulengé-Bréger chronographs connected to the AB electric circuits give a precision characterized by a mean error of velocity of less than $\frac{V}{1000}$.

5. *Disadvantages of the method and particularly of the screen-targets.*—After its departure from the cannon the projectile is, during a certain time, still affected by the accelerating action of the powder gases. Now it is necessary that the screen A be sheltered from the blast and that during its flight from A to B the projectile be submitted only to the resistance of the air and the action of gravity. It is generally admitted that these conditions are obtained when the distance OA from the piece to the first screen is equal to 0.1 of the M. V. This rule is a little too severe for the small calibers which permit a diminution of OA to 300 and even to 200 calibers. The distance between the two screens, AB, is ordinarily taken as 0.1 of the V_o; and here are found the most favorable conditions, the LeBoulengé-

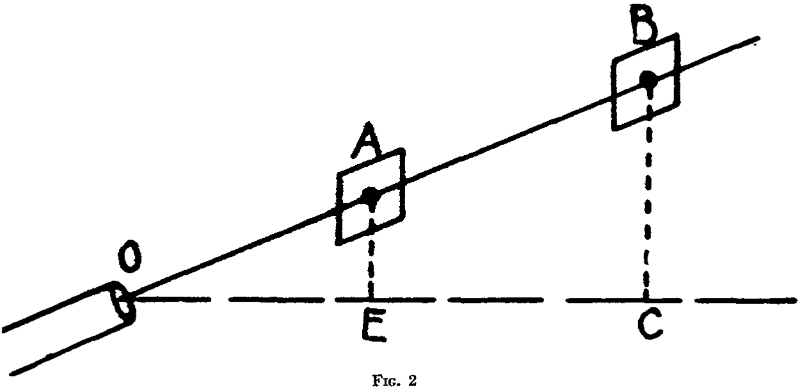

FIG. 2

Bréger chronographs being constructed for working with the maximum precision when they measure to the tenth of a second. The result is that OB is equal to or less than 0.2 of V_o. Now we already know that modern ballistics require, for the establishment of firing tables, a knowledge of V_o for each shot, and this requirement coupled with the employment of high muzzle velocities (1000 meters will become current) under high angles of elevation leads to the placing of the screen at great heights.

* * * * *

As these distances OE and OC vary with the muzzle velocity, at least one of the screens must be moved in accordance with the direction of fire. The screens are supported by frames, which under these conditions become enormous constructions, cumbersome, expensive, and hard to manipulate. So the removal of these inconveniences has been tried, firstly by replacing the screens by accoustic make-and-break appliances which require weaker supports, but the appliances are far from being workable and give only an insufficient accuracy and precision. Systems based on photography, electromagnetism, and optics have been experimented with but the trials, while encouraging, have not yet been finished. In any case they will give birth only to laboratory or proving ground appliances, more

or less delicate of manipulation and consequently unsuitable for employment on the battlefield. Finally, we should notice the recent use of the muzzle wire; the first screen is replaced by a wire situated at two millimeters from the muzzle and broken by the projectile before the latter has left the cannon, thus avoiding the breaking of the wire by the blast. This modification of the primitive system of two screens has consequently the suppression of one of the frames, the taller of the two. This scheme gives very good results.

* * * * *

8. *Conditions to be realized on the battlefield.*—We think that we have shown the importance of the factor V_o and the influence upon this value of the firing conditions (condition of the piece, temperature, and condition of powder), hence the necessity for directing our efforts towards the finding of a simple and practical process permitting the determination of the M. V. on the battlefield. If this process had at least the precision of the LeBoulengé-Bréger chronographs, that is, a mean error of $\frac{V_o}{1000}$, it is clear that indirectly we would have overcome the disadvantages of the appliances now in use in the proving grounds. Let us try to fix the conditions to be fulfilled by such a process. To be precise, simple and easily operated; to require, to the exclusion of all computation, only the reading of a dial or the use of a graphic table; not to necessitate complicated installation nor heavy, cumbersome or delicate apparatus; to be cheap; to use only instruments of current manufacture; and to require only slight modifications to the piece.

9. *Measurement of very small time intervals by the method of charging a condenser.*—The disadvantages of the LeBoulengé chronographs (tall frames) are due to the fact that these instruments measure with precision only times of an order of 0.1 of a second. The disadvantages could be attenuated if we could succeed in measuring much smaller time intervals (1/2000 of a second, for example). Further if we used the muzzle-wire arrangement we could arrive at the suppression of the second screen and its replacement by a second wire situated at a distance from the first such that the point of the projectile would cut the two before the rotating band left the piece. In this way the two wires could be fixed to a frame of 2.5 to 3 calibers in length to be placed on the piece at the time of the experiment. At a single stroke the two tall frames would be eliminated. Now the *Revue Générale de l'Electricité* (May, 1922, p. 690) describes a method of measuring very short times, a method responding to the conditions set forth in par. 8, above. Here is the description of the method as given by the *Revue:*

> A condenser C is charged by means of a constant electromotive force.
>
> 1. Across a resistance R and during a time t the charge accumulated is q, which is measured by a ballistic galvanometer.
>
> 2. If q_o be the entire charge it is known that the following relation exists between q and q_o:
>
> $$q = q_o \left(1 - e - \frac{t}{RC}\right)$$
>
> whence, approximately, at the beginning of the charge across R,
>
> $$t = RC \frac{q_o}{q}$$
>
> The measurement of t is reduced to two measurements of q and q_o by means of the ballistic galvanometer. The authors propose to examine the precision of this method.
>
> In their experiments, t is the time of flight of a bullet between two fine metallic wires, a and b (fig. 3) which it breaks successively. The

breaking of a permits the batteries to charge the condenser C across the resistance R. The breaking of b cuts the charging circuit. The charge accumulated during the time t is measured by the ballistic galvanometer by closing the switch K_1. As q_0 has been determined beforehand, t can be deduced. In these experiments t was of the order of 80 microseconds and the electrical measurements were exact to within 0.4% in general. The errors arise from the difficulty in obtaining the opening and closing of the circuits with precision at the beginning and end of the time interval to be measured. Klopsteg has been able to reduce the errors to 0.1 of those indicated. This method of measuring very short intervals is particularly adaptable in ballistics and in the study of the propogation of explosion in explosives.

This method is not new. It was used in 1900 by Edelman for calibrating the Helmholtz pendulum and for measuring the speed of contact breaking. The principle has since received the consecration of experience and has been subjected to the fires of criticism. It was brought to my attention by M. Yernaux, ex-professor at the C. I. S. L. A. A., now professor of electrotechnology at the University of Mons. Hence the merit of having thought of applying it to the problem of the measurement of V_0 belongs to this savant.

10. Before showing its application to cannon, let us see what objections can be made:

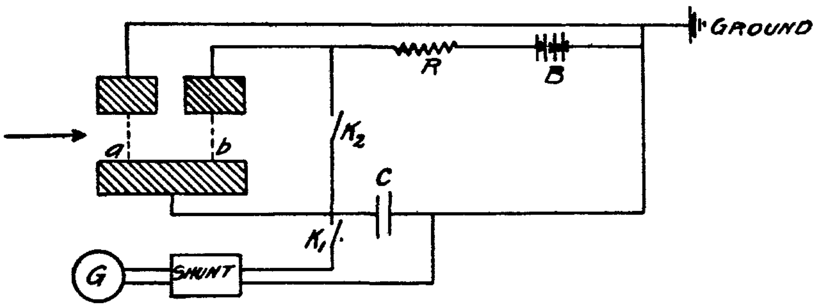

Fig. 3

(a) We know that after its departure from the bore, the projectile is still subjected to the accelerating effects of the gases, that the screens give the velocity at the middle point of their interval, C, and that ballistic formulae furnish a fictitious V_0, that is, the velocity with which the projectile, neglecting the above-mentioned action, should depart from the muzzle in order to have the velocity V at the point C. This fictitious velocity V_0 is the one which interests the artilleryman, as it is the one which must enter into the ballistic computations or be compared on the battlefield with the tabular velocity. Now the condenser process will give the real V with which the projectile leaves the muzzle.* To pass from the one to the other, it will suffice to calibrate, by several shots, each piece, that is to say, to compare the results given by the screens with the results given by the process in question. We will see besides, further on, that this calibration is necessary for another reason. Experiments performed at Brasschaet have shown that the difference between the real velocity at the muzzle and the velocity at the point C was constant.

(b) The precision of the measurement of V depends not only on the measure of the time t but also upon the breaking interval ab (fig. 3) as $V = \frac{a}{t}$. The origin-

*Or more exactly, the mean velocity with which the projectile traverses the breaking interval $ab = a$, between the two contact ruptures.

ators of this method have controlled the measurements and have obtained a precision greatly superior to 0.4% for times of an order of $\frac{80}{10^6}$ of a second, nevertheless let us adopt the figure of 0.4%. This means that the error to be expected (3.5 mean errors) will be equal to $\frac{4}{1000} \times \frac{80}{10^6} = \frac{32}{10^8}$ of a second; the mean error dt is hence equal to $\frac{32}{10^8} \times \frac{1}{3.5} = \frac{9}{10^8}$, approximately; it is almost certain that if we measure by the same means times greater than $\frac{80}{10^6}$ we will obtain the same precision, the latter depending only on the method and not on the magnitude of the measurement. Let us admit then that in the case of the cannon, dt be equal to $\frac{9}{10^8}$ and let us seek to evaluate the mean error da in terms of a such that the resulting mean error dV be less than $\frac{V}{1000}$, that is, smaller than the characteristic error of the chronograph and screens. Now following the law of the composition of errors:

$$dV = \sqrt{\left\{ \frac{dV}{dt}\, dt \right\}^2 + \left\{ \frac{dV}{da}\, da \right\}^2}$$

and remembering that $V = \frac{a}{t}$

$$dV = \frac{V}{a} \sqrt{V^2\, dt^{-2} + da^{-2}}$$

We have seen that the interval of breaking a can be taken equal to 2.5 to 3 calibers, or:

19 to 23 centimeters for the 75-mm. cannon,
26 to 32 centimeters for the 105-mm long.

(1) Let us take first the case of the 75-mm. cannon and suppose that V_o equals 500 meters, a equals 20 centimeters, and dt equals $\frac{9}{10^8}$. Let us introduce these quantities in the equation

$$dV = \frac{V}{a} \sqrt{V^2\, dt^{-2} + da^{-2}} \leqq \frac{V}{1000}$$

and solve for da. We find that $da \leqq 0.2$ mm., about.

* * * * *

In effecting these calculations, it is seen that the first term under the radical has a negligible value compared to the second so that, in a general manner,

$$\frac{da}{a} \leqq \frac{1}{1000}$$

So, in order that the mechanical system for supporting the wires be in accord with the electrical part of the process, the precision of current breaking must be very great.

* * * * *

Further on we will see the means which we recommend to assure this precision but let us say however that from now on the distance between the wires is constant from shot to shot because they are supported by a rigid frame. But it is the breaking of the current rather than the wires which should be rendered precise, that is to say, that the distance between the two positions of the projectile at the time it breaks the currents must have a mean error less than $\frac{a}{1000}$. In our system the currents are broken at the moment the projectile touches and bends the

wire, that is, well before the wire is broken. As a result of the speed of recoil of the piece, upon which is fixed the wire support, the latter is, with respect to the projectile, in variable motion. From this fact the absolute value of a suffers a variation corresponding to the variation of the speed of recoil between the two contact breakings. Calculations based on diagrams of the speed of the recoiling mass (obtained by experiment) prove that this source of error is negligible.

* * * * *

Conclusions.—Let us re-read the conditions enumerated in paragraph 6 above. We see that they have all been realized, save that one relative to the use of the ballistic galvanometer, an instrument rather delicate to handle. This galvanometer would render great service in the larboratory but on the battlefield it would be replaced by an instrument based on another principle, a portable instrument commonly used in electricity. Let us note, in effect, that what is required is only the measurement of the ratio of the two charges of the same condenser and not the charges themselves. Regarding this I have nothing further to say.

In reality the method presents only a novelty of minimum importance; two wires fixed to a support placed on the muzzle at the time of firing; there we have only a mechanical problem which our artillery engineers have easily resolved. What of the electrical part? Far from being new, it has been known and applied for a long time by electricians. Hence we can found a good deal of hope on the method here recommended. If these hopes are realized, the nightmare of gigantic screen-supports which haunts the minds of ballisticians will vanish.

Besides, if the captain could know at each moment the real dV_0 of his battery, the only elements which could still influence, in a harmful manner, the accuracy of his fire would be the atmospheric elements. Here we can appreciate the importance of the dV_0 on the battlefield as map firing (unobserved fire) would acquire a much greater efficacy with a lesser consumption of projectiles.

APHORISME XIX

Nothing is more necessary in a Generall than the perfect exploration of the courses his enemy takes, and a true estimate of the forces hee bringeth; For by the ignorance of the first, and the misprision of this other, hee makes his preparations, and builds his actions upon supposals and slippery grounds, bereaving himselfe of many faire advantages.—Ward's Animadversions of War *(London, 1639).*

Fortress Facing the Sea

By Major E. L. Dyer, C. A. C.

DEDICATED TO THE COAST ARTILLERY

Where the bleached sand meets the ocean,
There's a place attuned to me;
Care is a stranger there, the builder's hand is free,
And I love to dream by thy green-topped walls,
Fortress facing the sea.
Under thy guns the merchant ships furrow their solemn way,
And the white-wings, sailing, sailing never know a fairer bay;
Behind thee a nation sleeps, nor shall foeman touch our shore
Though he knock with a gauntlet of steel 'gainst our granite paneled door!
In the port where thy rock-bound terraces break the galloping waves and tide,
In the shadows sheeting thy parapets, where the ocean current fumes and frets,
Secure our navies ride.
Thou shalt number the days of kings; armadas are fragile things, 'gainst the blast of thy fiery hiss.
Unfurl thy banner high, a sylph in the azure sky, where the wheeling sea-gulls fly,
Sea-girt Acropolis!

I love thee well in the summer days,
Blue is the beautiful sea;
Bright is the lamp Delight, buoyant Love's ecstacy;
Sweet the siren lying in the sighing crystal waters,
Chanting Life's melody.
But I love thee best in the raging storm, defying the hurricane
That masses the Deep in mountains, that crushes the oak like grain!
High leap the breakers wild, and the Valkyr storm clouds shriek
O'er the floundering ships; in the thunders the Gods of Chaos speak.
'Gainst the maelstrom of sundering blast and wave, thy bastions buttress the land;
O'er the deluge of the grinding sea, the roving lightning pictures thee
Impregnable and grand!
Still imperturbable, sublime, a rock in the rapids of time, a cliff 'gainst the whirlpool's commotion!
Like the Fortress, fearless, bold, may I face the uncontrolled, lightning tippéd, titan foaled,
Storms of Life's ocean!

COLONEL JOHN P. STORY

Commandant Artillery School, March 11, 1902–January 24, 1904

COAST ARTILLERY BOARD NOTES

Communications relating to the development or improvement in methods or materiel for the Coast Artillery will be welcome from any member of the Corps or of the Service at large. These communications, with models or drawings of devices proposed, may be sent direct to the Coast Artillery Board, Fort Monroe, Virginia, and will receive careful consideration. **R. S. Abernethy, *Colonel, Coast Artillery Corps, President Coast Artillery Board.***

New Projects Received and Initiated During the Month

Project No. 537, Program for 3-inch AA Test Firing (Trial Shot Problem). —A special allowance of ammunition has been allotted for the 60th, 62d, and 63d Antiaircraft regiments to fire experimentally to test out different trial shot suggestions.

Project No. 538, Program for 155-mm. Gun Test Firing (Terrestrial Sound Ranging).—The Coast Artillery Board has been directed by the Chief of Coast Artillery to prepare a program for the firing of 38 rounds of 155-mm. G. P. F. ammunition to cover the development of terrestrial sound ranging and such other development of special features as the Coast Artillery Board may deem necessary.

Project No. 539, Program for 12-inch S. C. Mortar Test Firing (Zone to Zone Correction).—The Coast Artillery Board has been directed by the Chief of Coast Artillery to prepare a program for the firing of 30 rounds of 12-inch seacoast mortar ammunition with a view to solving the zone to zone correction problem. The program will be carried out by the 3d Coast Artillery, Fort MacArthur, California.

Project No. 540, Fast Towing Target.—The Chief of Coast Artillery has directed the Coast Artillery Board to prepare an estimate of the cost of a fast towing material target. Two designs, based on similar targets used by the Norwegian Coast Artillery service, have been submitted to the Coast Artillery Board for study.

Project No. 541, Confidential.

Project No. 542, Range Elevation Table, Aliquot Part Charge, 824-lb projectile, 12-inch Mortar, Models 1890 and 1908.—The Coast Artillery Board has recommended the construction of a Range-Elevation Table, Aliquot Part Charge, 824-lb. projectile, for 12-inch Mortars, Models 1890 and 1908. The present standard charge for this projectile, which is used in one zone only, is of the base increment type. Range tables for the 824-lb. projectile using the aliquot part charge have not heretofore been considered.

Project No. 543, Design of Ford Battery Computer.—The Coast Artillery Board recommended certain minor modifications in the manufacturer's design for test.

Project No. 544, Form of Meteorological Data.—The Coast Artillery Board has been directed by the Chief of Coast Artillery to report on the desirability of using the Coast Artillery School form for recording meteorological data instead of Meteorological Form W. D. 201.

Project No. 545, Basic Allowances of Equipment, Sound Ranging Battery. —The Chief of Coast Artillery is revising tables of basic allowances of equipment for Sound Ranging Batteries. The Coast Artillery Board has been directed to submit comments and recommendations on changes believed necessary and desirable.

Project No. 546, Method of Attaching Igniter to Powder Charge.—There have been cases where igniters have become detached from powder charges when the charge was rammed. This has occurred in the case of major-caliber guns where the igniters are attached by means of two safety pins. The pressure of the rammer caused the safety pins to open, allowed the igniter to fall down, and thus prevented the closing of the breech block. The Coast Artillery Board has submitted its recommendations on this subject to the Chief of Coast Artillery.

Project No. 547, Test of Stephens Predictor.—The Coast Artillery Board has been directed to conduct a service test of an arsenal constructed Stephens Predictor, reported on under Coast Artillery Board Project No. 419.

Completed Projects

Project No. 495, Modification of Elevation and Correction Pointers on AA Sight for 3-inch AA Gun, Model 1917-1918

I—History of the Project.

1. In connection with the modification of antiaircraft sights for the 3-inch antiaircraft guns, M 1917-1918, a model of new elevation and correction pointers was sent to the Coast Artillery Board for test. The new pointers are over twice as long as those now installed and are counter-balanced to relieve the angle of site mechanism of the torque which would otherwise be imposed. A magnifying glass was put on to facilitate matching the index lines.

II—Discussion.

2. The new pointers were first tried on the M 1917 gun, fixed mount; later it was put on the M 1918 gun on M 1917 trailer mount. To install the new pointers on the M-1917 guns, fixed, it was necessary to chip off an edge of the elevation assembly housing in order to eliminate the slight interference between the latter and the reinforcing rib of the pointer. The pointers were assembled on the 1918 trailer mount gun without difficulty.

3. The matching of lines on the two pointers is subject to an angular error which is inversely proportional to the length of the pointer arms. The new pointers, by their length, should reduce this error by one half that now encountered. This was tested on a gun equipped with the old pointers. The lines were carefully matched and the elevation of the gun checked by clinometer. The gun was then moved in elevation and the elevating detail was required to return the gun to its original position. When the lines were in apparent coincidence, a reading was made with the clinometer. This was done about fifty times; the error averaged three mils.

4. The same test was made using the new pointers. The error never exceeded one mil, and averaged less.

5. One possible disadvantage is that the increased length increases the liability to damage by personnel (grasping pointers for assistance in mounting to the elevating detail's seat) or by being caught or rubbed by the paulin when the gun is being covered or uncovered. This was tried, a paulin being put on and taken off in the usual manner. The paulin rubbed on the pointers but not more so than on other protruding parts of the gun and carriage, as the sights, etc. With ordinary care, no damage should occur.

6. Both the heavy black "checker board" index lines and the fine lines have merit. Some persons prefer to match the fine lines, others the edges of the heavy lines or blocks. The retention of both, as on this test model, would permit the operator to observe by the heavy lines when first "getting on" and to follow by matching either the fine lines or the heavy line edges according to personal preference.

7. The magnifying glass is not only unnecessary but may cause confusion under certain conditions of light. Glare from the sun confused the reader during the tests. This could easily occur with lighting equipment at night.

III—CONCLUSIONS.

8. It is the opinion of the Coast Artillery Board that:

a. The experimental elevation and correction pointers provide a means of improving the accuracy of the sighting system of the 3-inch AA guns.

b. Both the heavy and black indices should be on the pointers.

c. The reading glass should be eliminated.

IV—RECOMMENDATIONS.

9. The Coast Artillery Board recommends that the long elevation and correction pointers marked with a heavy block index and a fine line index, without reading glass, be supplied to all 3-inch antiaircraft guns, Models 1917 and 1918.

V—ACTION OF THE CHIEF OF COAST ARTILLERY.

The conclusions and recommendation of the Coast Artillery Board in the enclosed Project No. 495 are approved.

APHORISME XXVIII

Bloud flesh and bones are the least strengthning to the arme, unlesse there bee sinewes to stretch out and pull in for the defence of the bodie: So an Armie consisting of many valiant men, and furnished with all other warlike habilements, is but lame and uselesse, and unable to move it selfe without money the sinewes of Warre.—Ward's Animadversions of War *(London, 1639).*

MILITARY NOTES

furnished by

THE MILITARY INTELLIGENCE DIVISION, G. S.

Japan

ARMY PIGEON SERVICE.—The use of pigeons in the Japanese Army may be said to have commenced in 1919 when a French pigeon expert came to Japan under contract with the War Department bringing with him 1000 pigeons. Under direction of this official the Japanese pigeon service was organized and the training of the personnel in the handling of the birds and of the birds themselves was commenced in Nakano, a suburb of Tokyo.

With the departure of the French expert the development of the pigeon service was continued by Japanese Army officers, the number of birds under training having been steadily increased, until, at the end of the fiscal year 1926, there were 3135 trained birds in the lofts at Nakano.

The Japanese Army believes that in their carrier pigeons they have an asset of great military value. Each division, school, and coast artillery post now maintains a loft where training is continuous throughout the year. At all division and higher maneuvers pigeons form a regular part of the communication system and are said to be superior to the wireless in speed and accuracy. At the Grand Maneuvers pigeons were seen carried in bamboo baskets on the backs of cavalrymen and infantrymen and in specially constructed cages on motorcycle side-cars.

Military pigeon sections have been organized consisting of an officer, a non-commissioned officer, and six privates. These units gave excellent service during the recent disturbed conditions in North China when the International Military Trains between Tientsin and Peking were interrupted during the winter of 1925-26. Pigeon sections were carried on the International Trains, the pigeons being released when the train was, for any reason, held up at intermediate stations where wire communication was impossible to either Tientsin or Peking. The Japanese report that in no single instance was there a failure of the birds to return to their lofts even though they had to traverse zones of active fighting, distances of 28 to 40 kilometers being made in from 35 to 50 minutes.

AVIATION TRAINING FOR CADETS OF MILITARY ACADEMY.—With a desire to emulate the example set by the United States Army, the Japanese military authorities have commenced agitation to give all officers of the Army flying training for about 10 hours a year. However, financial conditions in Japan will not permit of any such extensive program—consequently it has been recommended to the War Office that all cadets at the Military Academy be given at least five hours of training in flying every year at Army flying schools and at Air Regiments. It is proposed to make this instruction compulsory for all students. This course of training will not entail any great outlay of money, and it is possible of consummation, whereas to give such training to all Army officers, is financially impossible.

Italy

Physical Training in the Army.—The value of physical training was recognized by the Italian Army after the World War, and as a result the Central School of Physical Education was founded in 1922 at Farnesina, a suburb of Rome, where before the war the National Rifle Club of Italy maintained a target range. This plant was taken over by the government for athletic instruction. The buildings consist of the usual administration building with dormitories and mess halls for the student officers, instructors, and enlisted personnel. There is a splendid gymnasium with fair equipment and an excellent athletic field. The climate in this part of Italy is such that instruction can be given out of doors practically the year around.

The primary object of the school was to give athletic training to junior officers of the army who, on the completion of their course, would return to their regiments as physical training instructors for the enlisted men. The first courses were of three months' duration. Later a special nine-months' course was instituted for those officers who made the best record in the three-months' course. The object of this longer course was to train officers to direct the physical training in regiments, recruiting schools for officers and noncommissioned officers, and divisional centers of physical training.

The actual instruction at the school is given by a staff of eight expert physical training instructors, and includes the following:

Simple setting-up exercises, equilibrium, turning, climbing, suspension, etc. (horizontal bar, vaulting horse);
Games: relay racing, flag racing, war;
Sports: football, basketball, volleyball.

As regards actual physical training in the army, a certain amount of athletic equipment has been distributed, and with officers trained to carry on the work an improvement in the physical development in the Italian soldier has resulted. Not only the army but also the civil population is showing more and more interest in sports.

As a result of the benefits from physical training in the army, Mussolini decided to introduce it in the National Security Militia, and consequently in 1925 courses at the Central School at Farnesina were opened for Militia officers. These courses have been of three-months' duration and have continued up to the present time. In this connection should be mentioned the fact that the Militia is now charged with the pre-military training of the Italian youth, and this training is largely physical.

Now for the first time the school has been opened to *sottufficiali* (senior noncommissioned officers) of the army. The first course began January 15, 1927, and lasted three months. Each Army Corps sent eight *sottufficiali*, therefore a total of eighty attended this course.

France

New Pay Rates for the French Army.—The rates of pay for officers and noncommissioned officers in the French Army have been increased to correspond somewhat to the increased cost of living. Although their pay is now three times what it was in 1914, the retail price index is approximately six times what it was then. As a result their pay has suffered a net reduction of about half, even with the present increase. The present change increases pay proper. The allowance for military expenses (*charges militaires*) is reduced slightly, part of it being incorporated in the new schedules of pay proper.

A War Department Bulletin gives the various new pay tables. These pay tables are far more complicated than those in use in the American Army. Instead of there being a fairly uniform pay basis for all officers, practically no two officers in the French Army receive exactly the same pay. This is due not only to the fact that pay is based on rank and length of service but also to the many allowances. It has been said that few officers can compute their own pay and allowances; it takes an expert in such matters.

Probably the most unusual allowance given French military personnel, certainly the most interesting one from the point of view of principle involved, is the one for *Charges Militaires*, or for extra expenses incidental to the military service. All government officers and employees, including Military, Naval, and those of the other Ministries, are paid according to the same pay schedules. By the institution of the allowance for *Charges Militaires* there is recognized the fact that military personnel occupy a peculiar position in the eyes of the government and public which necessitates greater expenses. This allowance is intended to defray, at least to some extent, the additional costs incurred by military personnel and their dependents in entertaining, purchase of two sets of clothes (military and civilian), maintaining at all times a very neat appearance, riding first or second class in trains and subways accordingly as the person is an officer or higher noncommissioned officer), etc. The importance of this allowance is emphasized when it is compared with the pay for each grade. Thus it is noted that for bachelor officers it amounts to from 20% for lieutenants to about 6% for generals. Married officers receive about double the allowance for bachelors. Three scales of the allowance are in force, which are applied according to the cost of living at the station.

As a very great majority of French officers, probably 80%, are not furnished quarters in kind, their pay is based on the assumption that they must themselves provide quarters. When an officer is furnished quarters in kind, deduction is made from his pay, the amount varying according to his rank and to whether the quarters are furnished or unfurnished.

In computing pay for length of service all military service, as cadet, enlisted man, or officer is counted. In addition, constructive service is granted officers who have graduated from either of the two military academies. The course of instruction is two years at each school. To graduates of the Ecole Polytechnique (Engineer and Artillery), two years constructive service is credited, one year constructive service being credited to graduates of St. Cyr (Cavalry and Infantry).

Officers are allowed 45 days leave of absence with full pay per year. Ordinarily this leave can not be saved up or accumulated, but if service conditions prevent taking advantage of it one year it can be used during the next year. Under exceptional circumstances leave for one year with full pay may be granted. Each year a limited number of officers may be granted leave for two or three years without pay (usually to establish themselves in civil life). This year's Budget limits the number of such officers to 2000.

There is an allowance for all military personnel with children. The same rates apply to officers, noncommissioned officers and enlisted men. The following are the amounts granted per month:

For the first child	54 Fcs.
For the second child	72 Fcs.
For the third child	108 Fcs.
For the fourth and other children . .	120 Fcs.

Before publication of the new pay tables noncommissioned officers had received increases in pay for length of service after 5 years', 8 years', and 10 years' service. A new pay period has now been added: after 15 years' service, and it is contemplated creating an additional one during the year for those with over 20 years' service.

The following list gives an idea of the most important allowances:

Allowance for children (*charge de famille*).
Allowance for temporary absence (*absence temporaire*).
Allowance for military expenses (*charges militaires*).
Allowance for office expenses (*frais de service*, for commanding generals, commanding officers, and quartermasters).
Allowance for office expenses (*frais de bureau*, for quartermaster, finance officers, medical officers, post and organization adjutants).
Original allowance for uniforms (*première mise d'équipement*, granted to 2d lieutenants and high-ranking noncommissioned officers).
Allowance for change in uniform (*changement d'uniforme*, allowed when an officer or warrant officer is transferred from one regiment to another which has a different uniform).
Rental allowance (*indemnité de logement*, for noncommissioned officers and enlisted men).
Allowance upon commencement of a campaign (*entrée en campagne*).
Allowance upon departure for foreign service (*départ colonial*).
Allowance for special duty (*indemnité de fonctions*, for officers and noncommissioned officers in Air Service, at prisons, in Foreign Legion, etc.).
Allowance for special duty (*service extraordinaire*, for officers with dependants on duty at service schools).
Flying Pay, Day and Night Flying (*Vol de Jour, Vol de Nuit*).

China

Manchurian Armored Train.—A new armored train belonging to the Manchurian (Fengtien) forces recently made its appearance at Tientsin.

The train, bearing the name "Chihli," consists of six armored cars and an armored locomotive. The train is made up as follows:

1st, a flat car carrying railway materials;
2nd, an armored car carrying guns in turrets;
3rd, an armored car carrying a Stokes mortar;
4th, the locomotive;
5th, a combination kitchen car, commissary, and quarters;
6th, same as the 2nd, car with guns in turrets;
7th, same as the 1st, car with railway materials.

The cars carrying guns have a 75-mm. gun at the end of the car towards the end of the train. The gun is mounted on a fixed base in a turret having a sweep of about 270 degrees. The turret consists of two parts; the lower part, which is stationary, is fitted with rollers on its top rim upon which the upper part revolves. The gun is fired through a small slot. Mounted in a similar turret, but above and in rear of the 75-mm. one, is a 4.7-inch gun with a sweep of 360 degrees. On either side of the 75-mm. gun having a sweep of about one foot, firing through a slot.

Two machine guns firing through slots are placed on each side of the car which is also loopholed for rifle fire.

The car carrying the Stokes mortar has two machine guns firing through loopholes on each side of the car. About the center of the car is a hole, circular in shape, with diameter the full width of the car. The hole is rimmed with a piece of boiler plate extending six inches above the top of the car through which peepholes have been cut to provide observation. About five feet below this hole is a platform on which the Stokes mortar is mounted.

The cars are armored with a double thickness of heavy boiler plate placed about 14 inches apart. The space between these two plates has been filled with reinforced concrete. The engine is completely sheathed with boiler plate so as to make it almost identical in appearance with that of the other cars when viewed at a distance.

The entire train is heavily camouflaged with newly painted designs, the railway material on the flat cars being covered with camouflaged canvas.

The train was manned by some one hundred Russian officers and soldiers.

APHORISME XXIX

In unresistable tempests, where shipwrack is threatned, they disburden the Ship, lest themselves and all should perish: so it must fare with a wise Generall in the tempestuous stormes of Warre; hee must adapt his consultations and actions to the necessities of the times, and not expose the main to a manifest losse, by seeking to save the bye: Wisedome therefore is more requisite in a Chiefe than Valour.—Ward's Animadversions of War *(London, 1639).*

BOOK REVIEWS

The Armies of the First French Republic and the Rise of the Marshals of Napoleon I. Colonel Ramsey Weston Phipps. Oxford University Press. 1926. 5½"x 8¾". 362 pp. $6.00.

This work was prepared for publication by Charles F. Phipps, late Colonel Royal Artillery, son of the author. The father was a patient and thorough student of the history of the Napoleonic period, and at his death left a "great mass of typescript" including a "summary of the armies of the Republic and Consulate and of their campaigns, showing the future Marshals at various stages"—which he subsequently enlarged into a detailed history of each army, and much else.

The present volume contains the introduction and the detailed history of the "Armée du Nord," and its reception by the public is expected to guide the course of the son as to future publication.

The following from the "Introduction" will serve to indicate what the writer has undertaken:

> Twenty-six men were made Marshals by Napoleon. Their successes and defeats, their merits and defects had much to do with the long contest between France and Europe. . . . Yet I doubt whether many Englishmen have correct ideas on Napoleon's Marshalate. Nothing is more difficult than to get a true English list of Marshals. . . . Also the relative positions of the Marshals and of Napoleon are misunderstood. All owed their batons to him . . . yet in many cases it was not he that first raised them to eminence. . . . Had Napoleon never existed, or had he found his way young to the scaffold, a reader of the present day would know nothing of Bessières, Lannes, Marmont, Murat or Victor, but no historian could have helped mentioning Jourdan, Kellerman, Macdonald, Moncey, and Perignon, . . . while others such as Massena and Saint-Cyr would probably have found their way to fame.
>
> Now to understand the history and characteristics of the Marshals, as well as their relative positions and their feelings toward one another, we must go back to the schools in which they were trained, the Armies of the First Republic.
>
> My task is to give the histories of these armies, tracing in them the fortunes of the men, who afterwards became famous leaders.
>
> Now it is no technical or artificial division when I group a number of officers together, and call a certain army their school. Each of these armies acquired a history, style, prejudices and reputation of its own.

The foregoing seems necessary to describe and define the task Colonel Phipps set for himself, and in which this reviewer believes he achieved noteworthy success. That it is not confined too closely to the subject contributes as well to the enlightenment as to the entertainment of the reader.

A complete and authoritative list of the marshals with full names shows the following interesting classification:

"*Officers Class*": Kellerman, Berthier, Grouchy, Serurier, de Moncey, Macdonald, Davout, Perignon, Marmont.

"*Soldier Class*": Ney, Murat, Soult, Bernadotte, Lefebvre, Ouidnot, Jourdan, Victor, Massena, Augerian.

"*Civilian Class*": Bessières, Brune, Lannes, Suchet, Saint-Cyr, Mortier.

Prince Poniatowski, who belonged to the Empire period, is not dealt with.

The successive commanders of the "Armée du Nord" had two enemies to fight; the Allies in front, and the government (properly the misgovernment) at Paris. Dumouriez, who probably saved himself by going over to the Allies, was succeeded by Custine whose popularity with his men made him a victim of the jealousy of the government. Houchard followed him in command and to the guillotine. Jourdan escaped through the victories of Wattignies, Hondschoote, and Fleurus, but was displaced by Pichegeu who died in prison. Moreau avoided the death sentence by deserting to the Allies, only to be killed by a French shell.

In such a school were trained Ney, Macdonald, Murat, Davout, Bernadotte, Berthier, Brune, Grouchy, Jourdan, and Kellerman.

Although designed to be a "history of men and of the times they lived in, rather than a critical study of military operations" this work will be found well worth while as a concise and accurate history of the campaigns and battles of the Armée du Nord from 1791 to 1797.

The field is almost a virgin one, and this work almost unique.

If this interesting and valuable volume is in the nature of a fair sample, this reviewer hopes, as will every reader interested in the Napoleonic Wars, that nothing may prevent publication of the other histories and indeed of all the manuscript left by Colonel Ramsey Weston Phipps.—R. S. A.

The Causes of War and the New Revolution. By Tell A. Turner. Marshall Jones Co., Boston. 1927. 5"x 7½". 228 pp. $2.00.

Though apparently but another of the pacifistic texts with which the world is being flooded, this work is an astounding exception in its failure to shout against, but boldly to favor, adequate preparation for national defense. Nowhere does it assign such preparation for defense as a cause of war, and although it lists as one of the causes of the World War, "the thorough preparedness of the military forces and the constant temptation to use them," it includes as of equal causative weight "the unpreparedness of the humane forces at the beginning of the twentieth century" and "the easy going toleration of ominous military conditions by the friends of peace."

The purpose of this book is said to be, "first to help kill war; second to prevent its resurrection. . . . It seeks to set forth dispassionately a body of plain facts, drawn directly from some sixty principal wars of the last three hundred and fifty years." Here again the writer deserts the pacifist pack. He does confine himself to history except in Part II ("The New Revolution") and there, in his prophecy that the new revolution against war will succeed, in his confident hope that a new spirit is abroad which is adready leading faltering hearts to say "War shall be no more," he is perhaps no more optimistic than are many practical statesmen.

The argument is that after each great series of wars there is likely to be a lull, but the spirit of conflict returns because "none stands guard over the grave of war, none knows how to exorcise the evil spirit of war itself." Conceivably, with the help of the aroused masses, Hague conferences, League of Nations, disarmament conferences, and the World Court may *decree* the death of war, but "War is not dead, War is a spirit; . . . The thought life of the ages must be changed, the human attitude must be altered."

In the historical summary the underlying situation and causes leading to each war are stated briefly and, considering the brevity, with fair historical accuracy. There follows in each case a brief tabulation of causes. This section is by no means dry reading, and should be of considerable value for hasty reference.—R.S.A.